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Exploring the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools

A thesis presented by:

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DECLARATION

I, Risha Rambali declare that:

The research reported in this thesis is my original research and where the work of others has been used, it has been appropriately cited and referenced. This thesis has not been submitted for any degree or examination at any other university.

Risha Rambali	**Dr Vusi Msiza**
Student	**Supervisor**

DEDICATION

I dedicate this thesis to my phenomenal mother, **Sheila Rambali** who is the reason I am where I am today. Thank you for your unconditional love, and continuous support.

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ABSTRACT

The experiences of non-specialist teachers in relation to their subject and pedagogical knowledge remains under-researched both nationally and internationally. Scholarship reports that teachers' subject matter and pedagogical knowledge contribute significantly to their teacher experience. However, existing literature on the experiences of non-specialist teachers suggests that there is a disconnect between their knowledge and their practice, especially in the cases where they are teaching core subjects like mathematics. This study aimed to explore the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at schools in Tongaat, KwaZulu-Natal. To understand the participants' experiences, I used Shulman's (1987) model of teacher knowledge as the theoretical framework. In the study I adopted a qualitative approach and a case study methodology with two data generation methods. Data from the participants (non-specialist mathematics teachers) was generated using a semi-structured interview consisting of an hour and thereafter followed by a one-hour lesson observation. In this study, purposive sampling was used to recruit the participants. The data was analysed through thematic analysis and I adopted both inductive and deductive ways of interpreting the data. The study found that most of the participants experienced challenges teaching mathematics as non-specialists. The reasons varied amongst the participants, although a common finding was a lack of both subject matter knowledge and pedagogical content knowledge. The study also found that most participants lacked passion, and this affected how they implemented the curriculum. Furthermore, another crucial finding was the lack of training and support afforded to the participants. The study has shown that all the above factors affect the quality of teaching and learning that takes place and therefore requires attention or intervention. The study, therefore, suggests that there is a need to understand the lived experiences of non-specialist teachers and to provide specialised training and support for them through workshops and mentorship. The study also suggests that the Department of Basic Education, should consider placing teachers in subjects that they specialised in.

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CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.1 Introduction and background

Schools are not only physical buildings; they are also hubs for lifelong learning. The social, cultural, and economic well-being of a country depends largely on teaching, which is one of the most demanding and respected professions (Lanier, 1997). Leading the way are teachers who are entrusted with this fundamental role. Since the dawn of a new democratic era in 1994, South Africa's education system has received significant attention. The evidence of the attention has manifested in several changes and curriculum reviews that took place in the country. These changes revealed more inequalities in the country and the education system. Teachers who are at the forefront of curriculum implementation faced the brunt of these rapid curricula changes owing to insufficient training and support (Fleisch, 2002). On this note, understanding teachers' experiences, feelings, and attitudes in relation to the profession is of paramount importance. Gaining insights into their experiences, various stakeholders will be able to understand the nature of different classroom and areas of intervention. South African public schools have been shown to be underperforming, especially in mathematics. For instance, the Trends in International Mathematics and Science Study (TIMSS) (2003) reported that 68% to 90% of African origin boys and girls in Grade 8 did not meet the low international benchmark in mathematics (Mullis et al., 2012), and regrettably neither TIMSS 2007 nor TIMSS 2011 showed any notable improvement. In the latest TIMSS 2019 report, in which 64 countries participated, South Africa was ranked among the three lowest-performing countries (Reddy et al., 2016). These statistics indicate a challenge with mathematics in South Africa. According to Nautiyal (2012), mathematics is a subject that is used in every industry and profession. Roberts (2017) states that there is a concern in South Africa over the poor performance of mathematics in the classroom. Likewise, Pausigere (2014) claims that South Africa's mathematics education system is in crisis. When determining the reasons behind learners' poor performance in mathematics, the opinions of mathematics teachers are crucial. The knowledge and attitude of mathematics teachers have a significant influence on whether learners enjoy or despise mathematics (Farooq & Shah, 2008; Domino, 2009). Venkat and Spaull (2015) argue that, because mathematics is taught predominantly by non-specialist teachers in public schools, it has an impact on how mathematics is taught and learned because the teachers lack subject and pedagogical knowledge. However, this concept has not been

thoroughly investigated. In light of mathematics being one of the most important subjects, it is imperative that the issue owing to poor performance in mathematics is looked into and possible solutions are developed and applied. The study by Venkat and Spaull' (2015) indicates that primary schools are dominated by non-specialist mathematics teachers. This study thus aims at exploring the experiences of non-specialist mathematics teachers in relation to curriculum implementation in the intermediate phase. The chapter will discuss the problem statement, rationale, focus and purpose of the study, followed by the objectives, research questions and significance of the study. Lastly, I will present the overview of the study and the conclusion.

1.2 Problem statement

South Africa's budget for education is significantly high and exceeds that of most sub-Saharan African countries (Mlachila & Moeletsi, 2019). For the financial year of 2022/2023, South Africa budgeted about R29.6 billion on education compared to other countries who spend less than that (Department of Basic Education, 2022) However, the country continues to experience serious challenges with the level of educational achievements, whereas a significant number of sub-Saharan African countries such as Kenya and Mauritius spend less on education but have better educational outcomes. The International Association for Evaluation of Educational Achievement ranked 39 countries, with South African grade nine learners coming in last for science proficiency and second-to-last for mathematics performance (Mabena et al., 2021). As noted earlier there are major challenges with mathematics teaching and learner performance in South Africa. The principal factors in explanation are complicated and multifaceted and are associated with insufficient subject matter knowledge of some teachers, history, language, location and socio-economic status (Mlachila & Moeletsi, 2019).

According to the available research, teachers have an impact on learners and their poor performance in mathematics because they may deliver incorrect information or even skip content if they lack a solid understanding of their subject matter and pedagogical content knowledge (Asikhia, 2010). In 2007, the Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ) tested grade six teachers with questions aimed at learners in grade six. The teachers fared below average on the test (Spaull, 2013). The poor subject knowledge evident in most South African teachers makes it difficult for them to effectively assess the performance of their learners and, consequently, for them to raise the achievement of their learners (Van der Berg & Hofmeyr, 2017). Additionally, as highlighted earlier, mathematics is predominantly taught by non-specialist teachers, and what is evident is

a lack of research on the experiences of non-specialist mathematics teachers in relation to curriculum implementation. Therefore, this study seeks to explore the experiences of non-specialist mathematics teachers in the intermediate phase. Exploring their lived experiences will be beneficial in gaining insights into the possible reasons for poor performance in mathematics. In the next section, I discuss the rationale of the study.

1.3 Rationale

The motivation to conduct this study is twofold; the first is my identity as a non-specialist mathematics teacher who has personally experienced challenges in implementing the curriculum and the second are scholarly reasons. To expand on my personal reasons, I specialised in Natural Science and Life Orientation in my initial teacher education. Upon obtaining my degree and being offered a permanent position as a teacher, I was placed to teach mathematics in Grade 4. As a novice teacher who had just exited university, having had specialised knowledge of only what was studied and then finding myself having to teach a new subject came with several challenges. These challenges impacted on my teacher identity and affected my professional life. The main challenge was familiarising myself with the mathematics curriculum and finding methods to teach the different sections in the way that they were required to be taught. In essence, my challenges stemmed from a lack of expertise and knowledge in relation to teaching mathematics.

According to the Norms and Standards of South African Teachers, the teacher as a subject specialist is expected to:

> *"be well grounded in the knowledge, skills, values, principles, methods, and procedures relevant to the discipline, subject, learning area, phase of the study, or professional or occupational practice. The educator will know about different approaches to teaching and learning, and how these may be used in ways which are appropriate to the learners and the context. The educator will have a well-developed understanding of the knowledge appropriate to the specialism"* (as cited in DoE, 2000, p.14)

My practice as a mathematics teacher contrast with what is stipulated by the Norms and Standards. As mentioned earlier, my knowledge of the subject is limited and will not be of the same level as that of a specialist teacher. As challenging as it was, I engaged in self-teaching

by watching videos and reading mathematics books. One reason for my engaging in this study is that I will be able to learn how other non-specialist mathematics teachers navigate through the curriculum and how it impacts on their professional self and practice. Whilst conducting research, I discovered that there are limited numbers of studies that have explored and reported on non-specialist teachers. The studies that were found mainly reported on the shortages of specialist teachers that led to the employment of more non-specialist teachers. Darlington's (2017) report conducted in British schools highlighted the high numbers of non-specialist teachers. Crisan and Rodd (2017) study also reported on the shortage of mathematics teachers hence the high number of non-specialist mathematics teachers. Locally, Jojo's (2019) study analysed the mathematics education system in South Africa and identified reasons such as teacher training and empowerment as being the major factors contributing to the poor performance in mathematics. Drawing from the above discussion, it is apparent that the experiences of non-specialist mathematics teachers are under-researched, especially with regard to the effect their teaching has on the performance of learners. The evidence of poor performance is a cause for concern (Venkat & Spaull, 2015). Therefore, I am exploring the experiences of non-specialist teachers in implementing the curriculum in the intermediate phase at Tongaat schools. The non-specialist teachers' experiences can provide insights regarding their practice and can possibly contribute towards the efforts of overcoming the poor performance in mathematics. In the next section I will present a discussion on the focus and purpose of the study.

1.4 Focus and purpose of the study

This study focuses on seven non-specialist mathematics teachers in the intermediate phase located at Tongaat schools in Kwa-Zulu Natal, South Africa. The purpose of the study is to understand how non-specialist mathematics teachers implement the curriculum. By conducting this study, I intend to contribute knowledge on the phenomenon of non-specialist teachers, especially noting an increase of non-specialist teachers in mathematics and other subjects in schools.

1.5 Objectives of the study

The objectives of the study are:

1. To explore the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools.
2. To understand how non-specialist mathematics teachers implement the curriculum in the intermediate phase at Tongaat schools.

1.6 Research questions

1. What are the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools?
2. How do non-specialist mathematics teachers implement the curriculum in the intermediate phase at Tongaat schools?

1.7 Significance of the study

The previous section indicated the lack of research conducted on the experiences of non-specialist mathematics teachers in relation to curriculum implementation. It has been established that the teaching of mathematics in South African schools is among the poorest in the world (Jojo, 2019). However, the studies that have been conducted did not investigate the role, contribution or impact of non-specialist mathematics teachers have on the poor performance of learners. As highlighted earlier, Venkat and Spaull (2015) found that most non-specialist teachers are found in primary schools. Primary schools generally comprise grades R to grade 7. This phase in a learner's schooling life is considered to be the most important phase, as the basics are taught here, such as counting, recognising shapes, and solving mathematics problems. Alluding to this fact are Mntunjani et al. (2018), who argue that the mathematical proficiency of learners is correlated with their comprehension of number concepts anchored in the foundation phase. On this note, the study is significant as it focuses on the experiences of non-specialist mathematics teachers located in primary schools, a phenomenon that appears to be neglected/unseen in educational research, yet significant. The study aims to understand their experiences and how they implement the curriculum as non-specialist teachers. Furthermore, this study will potentially contribute to the international literature for countries that are also facing the same challenge. I am also hopeful that the study will create an awareness of non-specialist teachers' experiences and potentially contribute to policy development or revision.

1.8 Chapter overview

Chapter one:

This chapter has presented an introduction and background to the study. The rationale, focus and purpose of the study were also discussed. I also discussed the significance of the study.

Chapter two:

Chapter two will provide an overview of the history and development of the South African schooling system pre- and post-apartheid. Thereafter, I will present literature that is organised according to context, i.e. international and local (South Africa). Furthermore, the chapter will review the literature on specialist and non-specialist mathematics teachers and outline the potential gaps in the existing literature.

Chapter three:

Chapter three will present the theoretical framework that underpins the study. The theoretical framework that I have chosen is Shulman's (1987) model of Teacher Knowledge. Shulman's model will assist in gaining an understanding of non-specialist mathematics teachers' experiences and their subject matter knowledge.

Chapter four:

In this chapter, a detailed discussion of the methodology used for this study will be presented and analysed. The research approach (qualitative), research paradigm (interpretive), methodology (case study), sampling (purposive and convenient), and data generation methods (semi-structured interviews and observations) will be discussed. The chapter will also discuss the trustworthiness, researcher's reflexivity, data analysis approach, and ethical considerations along with the limitations of the study.

Chapter five:

Chapter five presents a discussion on the data generated. I present the data in the form of themes. The themes were identified using Braun and Clarke (2006) six stages of thematic analysis. The data comprises of these themes: 1. Becoming a teacher, 2, Teachers' curricular knowledge, 3. Challenges in teaching mathematics and 4. Teachers' future plans.

Chapter six:

Chapter six is a concluding chapter that amongst other things will present a discussion of the key findings, and implications for policy, practice, and future research. Lastly the chapter presents an overall conclusion of the study.

1.8 Conclusion

In the chapter I presented the introduction and background of the study. I outlined the background, problem statement, focus, and purpose of the study. Thereafter, the rationale, key research questions, objectives, and significance of the study were discussed. Finally, I presented a discussion of the overview of each chapter. The chapter highlighted briefly the issue of poor performance in mathematics. A discussion on the lack of research on non-specialist mathematics teachers' experiences was also presented. The next chapter will review and discuss existing literature on the phenomenon of the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

A literature review "can identify what is known (and unknown) in the subject area, identify areas of controversy or debate and help formulate questions that need further research" (Bolderston, 2008, p. 86). Johnson and Christensen (2004) highlight the purpose of a literature review as being able to provide an understanding of the contemporary state of knowledge about the selected topic of study. Fundamentally, through a literature review scholars are seeking to ascertain what research has been conducted in relation to the problem under study (Gay, 1992 & Creswell, 1994). In line with the above definitions, this review of literature draws on studies conducted in South Africa and internationally on the experiences of non-specialist mathematics teachers in implementing the curriculum. I will first unpack the South African schooling system pre- and post-apartheid and thereafter discuss literature on education, in particular the local studies that have sought to understand the state of education in South Africa. Next, I will focus on how specialist mathematics teachers implement the mathematics curriculum in the intermediate phase.

2.2 Unpacking the South African schooling system pre- and post-apartheid

Primary schools in South Africa consist of two phases: Foundation Phase and the intermediate phase. The mathematics curriculum in the Foundation Phase comprises five content areas that are needed to be covered as stipulated in the Curriculum and Assessment Policy Statement (CAPS). These are "Number, Operations and Relationships, Patterns Functions and Algebra, Space and Shape, Measurement and Data Handling" (Department of Basic Education, 2011, pp. 10-11). According to Mntunjani et al. (2018) the foundational knowledge and skills required for mathematical learning for later phases are laid in this phase, starting from Grade R and continuing into grades 1-3. A foundation, as defined by Soanes and Stevenson (2004, p. 561) is the "lowest load-bearing part of a building, typically below ground level". This implies that if the foundation of a building is weak, it will not be able to bear the load it is meant to carry. Consequently, the result will be the collapse of the building. Likewise, in order to develop competent life-long learners, the base from which they come is imperative (Maimela, 2015). This base is primary school teachers who carry the responsibility of laying the right foundation for the learners.

In addition, Mntunjani et al. (2018) states that the content area, 'numbers, operations and relationships' forms the base for all the other content areas in the Foundation Phase. Therefore, Foundation Phase teachers are required to lay a firm foundation for learners in understanding number concepts, as this determines their proficiency in understanding other content areas (Engelbrecht et al., 2009; Mntunjani et al., 2018). In the intermediate phase, teachers who are tasked to teach mathematics focus on the same five content areas. Collectively, the knowledge acquired in both phases strengthens the learners' foundation as they progress through their schooling journey. Whilst Foundation Phase teachers play a pivotal role in strengthening learners' foundational knowledge, factors such as curriculum changes can affect the whole foundation. For instance, as teaching moved from being teacher-centred to being learner-centred, teachers had to change from technicians to facilitators and most teachers were semi-skilled and inexperienced to cope with the changes (Chisholm, 2004).

The TIMSS is an international standardised test for mathematics and science. In 2011, the TIMSS revealed that South African learners had the lowest performance among all 21 middle-income countries that participated **(**Bernstein**,** 2013**)**. In addition, recent evidence published from the Department of Basic Education on the TIMSS (2019) report, highlights the South African grade 5 mathematics and science results. In both subjects, South Africa was placed amongst the three lowest of the 64 countries who took part in the study for the grade 4/5 level. South Africa's poor performance in mathematics was linked to the numerous curricular changes. The birth of democracy in 1994 brought upon several changes in South Africa; however, perhaps the biggest change took place in education. The education sector saw the introduction of Curriculum 2005 (C2005) which was driven by the Outcomes Based Education (OBE) (Lizer, 2013). Thereafter, C2005 underwent a review process that led to the introduction of the Revised National Curriculum Statement (RNCS) and the National Curriculum Statement (NCS) (Pudi, 2006). Likewise, these policies also seemed to be troublesome which finally led to the current curriculum, CAPS, which was rolled out for the first time in 2012. One of the main focuses of these curriculum changes was aimed at addressing an education system that was characterised by racism, discrimination, and inequalities. However, literature has revealed that the implementation of curriculum changes in South Africa was more engrossed on the desired educational and political achievement than the how part of its implementation (Rogan & Grayson, 2003; Bantwini, 2009; Lizer, 2013).

Despite the government's efforts to incorporate new features into existing and established curriculum content, it is still widely thought that the democratic regime introduced multiple versions of curricula that were not homegrown and hence failed to respond to the difficulties facing society today (Jansen, 1998). One such example is how language was used to make education exclusive during apartheid and how it continues to do so by creating learning challenges in the classroom (Friedman, 2019). Saneka and de Witt (2019) concur with Friedman as they state that the English language is seen as a status of having power, privilege and is not just a political issue but also an economic issue. Friedman (2019) argues that the issue of English being the language of learning and teaching (LoLT) is that several learners perform poorly as they are not being taught in their mother tongue. According to Jordaan (2011, p. 79) "English continues to dominate as the preferred language of teaching and learning, at the expense and marginalisation of the African languages". Mathematics learning starts with language, progresses, and stumbles because of language, and its results are often evaluated in language (Durkin, 1991). On that note, Phakeng (2013) has already drawn attention to English being a challenge as being the LoLt whilst being taught mathematics. Whilst mathematics predominantly deals with numbers it is taught using language. Phakeng (2013, p. 3) states that "reflecting back on my own learning of mathematics in English, the greatest difficulty was learning in a language in which I was not fluent". On the other hand, this is a worldwide phenomenon, not just in South Africa. Similar circumstances have been observed in various parts of the world by different mathematics instructors and academics (for example, Barwell's early work with English learners in 2003, Moschkovich's 2015 work with Latino communities of learners in the United States, or Planas' 2014 work on well-established 'minority' languages in Catalonia) are just a few examples. Hence, Jordaan (2011) argues that the education system failed to deliver on the constitutional imperative of promoting multilingualism.

The foremost factor resulting in the poor performance of learners in mathematics in South Africa is teachers who are not ready and unable to implement the curriculum (Feza, 2014). Teachers are at the forefront of curriculum implementation. Therefore, how the curriculum is implemented is dependent on their subject matter knowledge, their interpretation of the curriculum, their training and the support provided to teachers (Loflin, 2016). The post-apartheid government rationalised qualifications and provided guidelines for teacher training, outlining the time frame needed to be devoted in each of the different types of knowledges (Kimathi & Rusznyak, 2018). However, Graven (2005) highlighted that there was a challenge

in selecting and integrating relevant knowledge and practices in mathematics teacher education at university level.

Curriculum implementation in schools is dependent on several factors such as the context, resources, teacher knowledge, staffing and their initial teacher education training (Maimela, 2015; Loflin, 2016; Nevenglosky et al., 2019). The segregated apartheid system of South Africa provided a different teacher education training for specific racial categories in the respective former homelands (McKeever, 2017). Teachers were trained in former teacher colleges that were in various parts of the country, including the townships and homelands. The college system in teacher colleges was preparing teachers to become 'technicians' of curriculum and not intellectuals (Msibi & Mchunu**,** 2013). In addition, Pinar (2004, p. 27) makes a similar argument that "teachers are reduced to technicians, 'managing' student productivity". Referring to the manner in which schools are managed, Pinar describes schools as resembling business sites and being no longer a place where intellectual work takes place. The introduction and the nature of C2005 were seen as strenuous to teachers, of whom a large cohort are products of teacher colleges. Maimela (2015, p. 4) is of the opinion that the intensification of "teachers work has, in turn, resulted in low morale among teachers and loss of confidence in their abilities". Pinar (2004) uses the term 'automata' to describe teachers, implying that teachers are seen as machines meant to do only what is expected of them. In addition, when teachers are immersed in identities created by others, their ability to cultivate intellect is inevitably limited and weakened (Pinar, 2004).

Contrary to the above, Feza (2014) argues that South Korea and Singapore had undergone similar curricular changes but have still managed to have their learners as the lead performers in the TIMMS. According to Smithers and Robinson (2013), the dominant distinction between countries that have a sturdy teaching workforce in mathematics (Finland, Japan and South Korea) and those with continuous scarcity (such as England, Australia, and the Netherlands), is that in the former, teaching is a high-status profession and education is sufficiently funded. Smithers and Robinson (2013) further indicate that Japan is recognised as a highly successful country in terms of education, following a 30% raise in teacher salaries. According to a study conducted by Yata et al. (2020) on Science, Technology, Engineering and Mathematics (STEM) based on Japanese subject principles, there has been an increase in interest surrounding STEM education. This comes after the United States reported the significance of STEM education for the advancement of the workforce in related fields (Yata et al., 2020).

Japan, as a result, followed suit and placed great emphasis on STEM education to promote employment and to strengthen their economy (Yata et al., 2020). Moreover, Singapore, for example, acknowledged that the rapidly changing world requires teachers to be abreast of the changes and has therefore provided mathematics teachers with an entitlement of '100 hours' of professional development each year (Schleicher, 2012).

Adler and Reed (2002) postulate that poor mathematics knowledge amongst South African teachers is rooted in the apartheid teacher education system. Expanding on this notion is Smith (2011), who states that separate schools for learners of various racial backgrounds were established, along with extremely unequal regulations, curriculum, and funding. During this time, there were several mandatory levels of schooling, with substantially lower standards for non-Whites. White schools placed a greater emphasis on academic subjects, but African schools placed a greater emphasis on 'practical' subjects that prepared students for the working sector. Adler (1994) indicates that, under apartheid, trainees were provided with limited opportunities to learn mathematics content knowledge (MCK) and mathematics pedagogic content knowledge (MPCK). As a result, teachers used the 'Tell and Drill' approach which is similar to the teacher-centred method of instruction where learner participation is limited and is mainly based on memorisation (Diko & Feza, 2014).

Furthermore, whilst there is a cohort of teachers who went through the apartheid education system, there are also some teachers who did not. Mabena et al.'s (2021) study have highlighted that mathematics teachers who were trained during apartheid are insufficiently experienced and do not possess pedagogical content knowledge (PCK). Chapman (2015) argues that teachers' mathematical knowledge and expertise are critical needs for engaging students in meaningful and effective mathematical practices in the classroom. Teachers attended intervention programmes and subject committee meetings only once per quarter that were organised by the subject advisors. According to Chapman (2015), this type of professional development is inefficient since it is not consistent and does not provide teachers with sufficient PCK. Similarly, Hofmeyr and Hall (1995) found the issue of poor subject knowledge evident in some teacher's pedagogical practices. According to Diko and Feza (2014, p. 1457) "after conducting a national/teacher education audit, they reported that under apartheid students acquired superficial knowledge of their teaching subjects". Superficial knowledge existed because there were no common qualifications, structure, standards, or norms to provide recommendations on how to train teachers during apartheid (Parker, 2003). In addition, the education system during

the apartheid era gave Black Africans the bare minimum of knowledge required for low-skilled jobs (Thobejane, 2013). Hence, this created a challenge primarily for those who were disadvantaged by these policies.

Moreover, nearly 20 years thereafter, with important policy changes in place, such as the Minimum Requirements of Teacher Education Qualifications policy (2008), the National Education Evaluation and Development Unit (NEEDU) (2012) guided by Nick Taylor, who also had been part of the National Teacher Education Audit in 1995, concluded that despite being appropriately qualified, as per the requirements of the Department of Higher Education, the majority of South African teachers still had poor subject knowledge in all subjects (Diko & Feza, 2014). As mentioned earlier, possible factors that could have caused teachers to have poor subject knowledge are due to the different types of training they received under the apartheid education system. The findings herein are similar to those made by the Education's NEEDU (2012). Bernstein (2013), in a report for the Centre for Development and Enterprises, confirmed that there is poor teaching of mathematics in South African public schools. Blömeke et al. (2011) compared the mathematical content knowledge (MCK) of Singapore, China, Japan and the United States. Their findings revealed high-performing scores with their mathematical pedagogical knowledge (MPK) scores and have concluded that the scores illustrate interdependence between MCK and MPK. Hence, both these knowledge are important for teachers to have. On the other hand, Schmidt et al. (2011) and Darling-Hammond (2006) argue that these knowledges are only helpful to teachers up to a certain point; teachers need to possess a range of abilities to teach effectively. Nonetheless, as highlighted earlier, this was not the case in South Africa during apartheid, as there were no uniform qualifications, structure, and norms to provide guidelines on how to train teachers (Parker, 2003).

Different countries develop and introduce different teacher training policies. Although it is most common for the majority of the countries to offer a four-year training qualification for teachers, other countries take longer than four years, for example, Taiwan and Germany its four years followed by a six-month full-time practicum (Taiwan) and four and half years with a further one and a half to two years (Germany) of practical training in school settings respectively (Diko & Feza, 2014). At present in South Africa, to be a fully qualified teacher, one must get a four-year degree from a teacher-education institution. German teachers, on the other hand, are faced with the longest education system in Europe. In Germany the teacher

preparation program is rigorous and inflexible as teachers acquire a solid foundation in their subject matter studies (Diko & Feza, 2014; Schmidt et al., 2011).

2.3 International and local literature on teacher education

"To be a teacher requires extensive and highly organized bodies of knowledge" (Shulman, 1985. p. 47). Many academic papers have documented the alarming statistics of the poor academic performance and the number of undertrained teachers in South Africa (Jansen, 2012; Metcalfe et al., 2012; Singh, 2015). The introduction of CAPS was meant to rid the education system of the past challenges brought upon by C2005 and OBE, however, it has been noted that CAPS has done very little to remediate the problems presented by the past curricula (Maharajh et al., 2016). Maddock and Maroun (2018) believe that many teachers choose teaching as their career choice simply because it is the only option they have. This finding could be one of the contributing factors to the challenges experienced by teachers and the education department, as this could imply a lack of passion for teaching. Anecdotal evidence indicates that teaching is unlike other professions, it requires passion. Moreover, the issue of a lack of training and support provided by relevant stakeholders is one of the additional problems facing the profession in South Africa (Nkambule & Amsterdam, 2018).

Internationally, Singapore is considered a highly successful country following its major international benchmarking tests and its teacher policy which has drawn the attention of many researchers and government officials (McKinsey & Company, 2007; Organisation for Economic Co-operation and Development (OECD), 2014; Goodwin & Low, 2018). Teachers in Singapore are well remunerated and have a relatively high status (Low et al., 2011) whereas in some countries teachers are not well paid and have a low social status (Richardson & Watt, 2006). Becoming a teacher in Singapore follows a unique process. Aspiring teachers need to apply to the Ministry of Education where they will be interviewed before being enrolled in the initial teacher education (ITE) programmes, at the National Institute of Education (NIE) (Low et al., 2017). These methods demonstrate the significance of the value on teacher recruitment.

In Low et al.'s (2017) study, they refer to the tripartite framework, which looks at three main teaching motivators; intrinsic, altruistic, and extrinsic motivations, as noted by Kyriacou and Coulthard (2000) and Moran et al. (2001). Intrinsic refers to the internal satisfaction where there is love for working with children and a passion for teaching in general. On the other hand,

altruistic motives refers to teachers who join the profession to contribute to their personal growth and the advancement of the society. Lastly, extrinsic factors refer to the perks of being a teacher such as the salary, vacations, working conditions and social status. A consistent conclusion from research undertaken in Western countries viewed through the lens of the tripartite model is that people are largely drawn to teaching for intrinsic and altruistic motives with the influence of extrinsic variables being significantly less prevalent (Kyriacou & Coulthard, 2000; Manuel & Hughes, 2006). That is, a number of people choose to teach because they enjoy working with children, a specific subject or teaching in general (Mee at al., 2012; Moreau, 2014) or because of the intellectual satisfaction that teaching provides (Butt et al., 2010). Teaching as a calling is another altruistic reason (Marshall, 2009; Mee at al., 2012) and the chance to make a difference in the lives of students and society (Ganchorre & Tomanek, 2012). External considerations such as high pay, long vacations and favourable working circumstances did not feature prominently.

Contrastingly, apart from intrinsic and altruistic motivations, studies in other countries such as African countries (Cross & Ndofirepi, 2013), Malaysia (Azman, 2013), Hong Kong (Gu & Lai, 2012; Lam, 2012), Turkey (Yuce et al., 2013) and Taiwan (Wang, 2004) have found that job security, high pay and remuneration and long holidays are among the main reasons for choosing teaching. These findings highlight the potential risks in teacher quality and the need for more effective recruitment strategies. Whilst there could be contextual uniqueness, these findings and comparisons can provide valuable lessons and principles that can be used to inform new decisions and policies in education in the countries mentioned earlier.

It is also imperative to look back at teacher colleges / universities to assess the quality of teachers sent out from these institutions. According to Bowie et al. (2019), first year Bachelor of Education (BEd) student teachers in South Africa who plan on teaching mathematics across three universities scored 52% on a primary school mathematics test, while final year BEd students scored 54%. This is an improvement of 2% over a 3-year period. Consequently, there is a need for university programmes that train teachers to undergo an audit before allowing these students to venture out into teaching. Below is a bar graph illustrating the test scores across the three universities from 488 first year students and 282 final year students. The test was designed to assess students' scope of knowledge of primary school mathematics knowledge drawn from the grade 1-7 curriculum. The results illustrated that most of the students lacked the basic understanding of primary school mathematics.

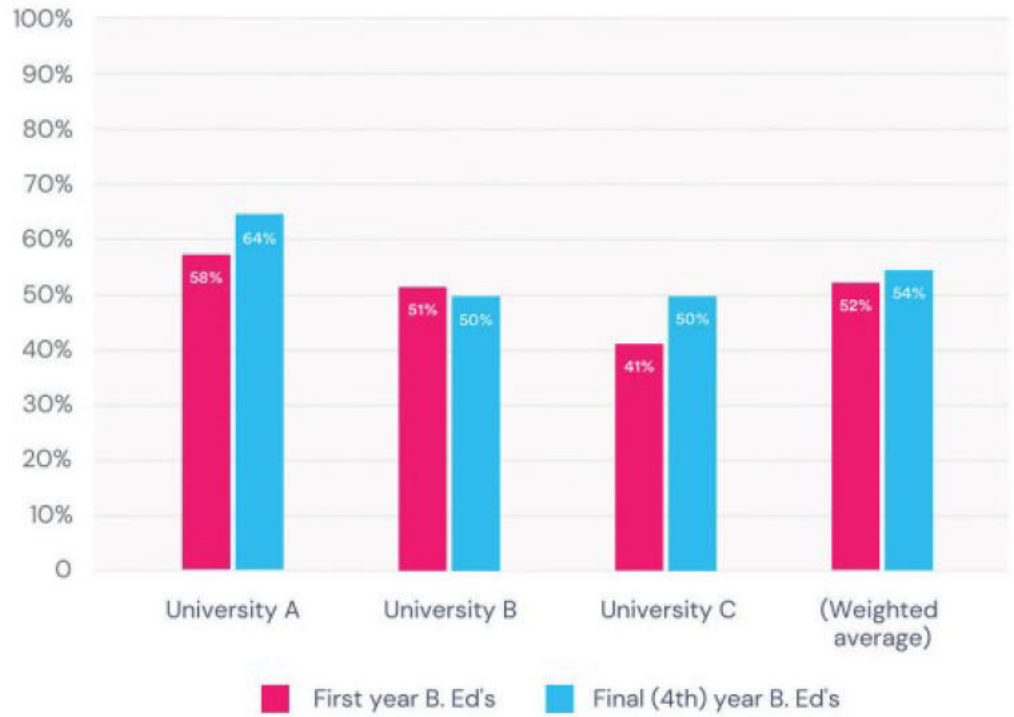

Figure 1. First-year and final-year BEd scores on a primary school mathematics test (2018)

(Bowie et al., 2019)

It is evident that students show little improvement from their first year to their final year. Mathematics is one of the core subjects and it requires specialised knowledge (Maamin et al., 2020), with highly knowledgeable students, however contrary to this, the results obtained from these universities demonstrate the lack of sufficient knowledge.

In Maddock and Maroun's (2018, p. 200) research, the teachers who were interviewed stated the following: "teachers have limited knowledge", teachers are giving marks to students who don't deserve those marks because the teachers themselves don't understand the content. This is contrary to the pedagogic aims stated by the Department of Education, of following the principles of active and critical learning and high knowledge and high skills (Department of Basic Education, 2011). These findings allow one to pinpoint where the foundational challenges lie; this stems from poor primary schooling which has a ripple effect. One such example, as noted in Maddock and Maroun's (2018, p. 204) study, was, as one of the respondents claimed, "children come to high school and they know far too little. I find it a bit of an issue when my secondary school teachers have to give writing lessons on the board". These remarks show the reality of what is happening at some schools, and it requires urgent intervention. It also shows that the challenges faced by university students with regard to mathematics are not isolated, in fact, they are deep-rooted. Ultimately, the status of the

profession needs to be improved and the criteria for acceptance are raised which should eliminate some of the existing problems. The next section will discuss how specialist mathematics teachers implement the mathematics curriculum and how non-specialist mathematics teachers implement the mathematics curriculum.

2.4 Specialist mathematics teachers and the implementation of the mathematics curriculum

Junqueiraa and Nolanb (2016) and Williams (2008) describe a mathematics specialist teacher as an educator who has in-depth mathematical knowledge and teaching skills. Amongst the knowledge and skills acquired by mathematics specialist teachers are subject expert knowledge, teaching approaches, and an ability to identify learners' misconceptions and provide critical solutions to their problems (Dibane, 2018). Teachers who have a solid command of mathematical knowledge have an assortment of teaching strategies at their disposal when faced with different situations in a classroom (Shulman, 1986; Kilpatrick et al., 2001; Darling-Hammond & Bransford, 2005). This is beneficial, as every learner is unique and having multiple teaching strategies enables the teacher to speak to learners' different styles of learning. Shah et al. (2013) also stress the importance of teachers being aware that learners differ from each other, hence they will differ in their preferred mode of learning, and whilst some may prefer visual/graphic, others may prefer to read/write.

To accommodate the learning diversity in the classrooms the teachers can draw from different strategies which are premised on either a teacher-centred or learner-centred approaches. Serin (2018) describes a teacher-centred approach as the teacher being the primary source of information and the textbook is the sole resource for classroom activities. Contrastingly, in a learner-centred approach, the learners play an active role in the learning process. Learners are given the opportunity to learn independently, which promotes critical thinking (Serin, 2018). However, Maimela (2015) asserts that a learner-centred approach is more demanding on a teacher. Chall (2000) indicates the adoption of a learner-centred approach requires constant planning, continuous innovation, a sensitive system of tracking learners' performance, and excellent skills in sustaining order without being authoritarian. In light of specialist teachers having gained specialised knowledge of mathematics, their lessons have the potential to be more interactive and beneficial.

Furthermore, Fennell (2011) states that mathematics specialist teachers have a particular knowledge interest and expertise in mathematics and can create the best environment for learning opportunities. This is due to the confidence that stems from a solid background of subject matter knowledge, backed by their qualification in the subject. Metzler and Woessmann (2010) found that teacher subject knowledge on learner achievement has a major causal impact on learner outcomes. Learners performed relatively better with teachers who had specialised knowledge. Likewise, Guimarães et al. (2012) researched the impact of teachers' content knowledge on learner achievement and found that teachers with a higher content knowledge had a greater positive impact on learner achievement. They can encourage learner participation and promote higher-order and critical thinking among learners (Dibane, 2018). Conforming to the same idea Jacob et al. (2020) believe that teachers who have a more in-depth content knowledge and is skilled at teaching a particular audience will have greater success with learners than a teacher who is less prepared or less seasoned. However, it is worth noting that there are instances where specialist teachers have specialised knowledge of the subject's content but lack the skills to apply what they know (Jeschke et al., 2021). The potential factor resulting in such instances could be a gap between the teachers' MCK and MPCK, whereby a teacher has sufficient MCK but is lacking in MPCK, signifying the importance of acquiring both knowledge categories.

Several studies have shown that teacher quality, of all the variables that can be controlled, is the one that has the greatest effect on student learning (Sanders & Rivers, 1996; Sanders et al., 1997; Goldhaber, 2002; Bennett, 2007). Darling-Hammond (2014) elaborates on 'teacher quality and teaching quality'; teacher quality could be described as teacher's traits, skills and understanding an individual brings to teaching, including subject skills and knowledge, along with personal beliefs. On the other hand, teaching quality refers to "strong instruction that enables a wide range of students to learn" (Darling-Hammond, 2014, p. 7). However, Sani (2019) indicates that if both teacher quality and teaching quality are good, difficult circumstances or limited resources will undermine the quality of teaching even for strong teachers. Thus, effective teachers in one setting are not necessarily the same in another (Berliner, 2001; Darling-Hammond, 2014; Wiliam, 2016). For instance, Finland boasts a high quality of teaching and learning. However, Finnish teachers would not be able to easily emulate their successes elsewhere as the context would be comprised (Sahlberg, 2011). "This suggests the system, the context, the curriculum, the students, the support networks, the resources, the teacher and the teaching interact in such a way that enables successful learning" (Sani, 2019,

p. 30). In the next section I discuss the literature on non-specialist mathematics teachers and the implementation of the mathematics curriculum.

2.5 Non-specialist mathematics teachers and the implementation of the mathematics curriculum

Loflin (2016) highlights the importance of understanding the role teachers play in curriculum implementation, which determines the curriculum's success or failure. Alsubaie (2016) declares teachers as the most important stakeholders in curriculum implementation. Nevenglosky et al. (2019, p. 36) indicate that "Curriculum implementation refers to how teachers deliver instruction and assessment through the use of specified resources provided in a curriculum". In a study conducted by Du Plessis (2018), it became evident that non-specialist teachers have grave difficulty in delivering the basics of mathematics. These difficulties stemmed from their personal experiences with the subject, their scope of knowledge, of the content needed to be taught, the lack of support and training and their inability to meet learners at their varying learning levels (Du Plessis, 2018). These findings are alarming as learners who do not acquire a strong basic mathematics knowledge in the intermediate phase will have challenges at a later stage. Askew et al. (1997), Hill et al. (2005) and Hodgen et al. (2010) allude to the critical role primary schools play in providing learners with the foundations for mathematical learning. To do so, requires strong mathematical understanding. McKinsey and Company (2007) stipulate that low-performing teachers teaching mathematics have a negative impact on learners and this is found to be more severe during the primary years of schooling.

Darlington's (2017) report conducted in British schools found that there is a high number of non-specialist teachers and discovered the following information on what a non-specialist is: (a) 47.9% of the participants who were asked why they consider themselves a non-specialist teacher stated that their degree was in another subject, (b) 538 Heads of Department (HOD) described non-specialist teachers as teachers without a degree in the subject and went further to state that it is someone without teacher training in that subject, and (c) a few other participants responded by stating it is teachers who are inexperienced in that subject or lacked confidence in teaching it. The study noted that the high number of "non-specialist teachers were found to be drawn from a range of experience and subject specialism, many of whom due to teacher shortages in their non-specialist subject" (Darlington, 2017, p. 6). Crisan and Rodd (2017) describe a non-specialist mathematics teacher as a teacher who has qualified to teach a

subject other than mathematics yet still teaches mathematics. Their study also indicated a shortage of mathematics teachers in England, thus the reason for the high number of non-specialist mathematics teachers. This suggest that the definition of a non-specialist mathematics teachers is contextual and varied.

The teaching of mathematics is unlike any other subject. A teacher needs to have the necessary content knowledge and an array of teaching methodologies, as the teaching of mathematics shows learners that there is more than one way or method of solving a problem (Dibane, 2018). In the absence of these fundamental aspects, the teaching and learning of mathematics is likely to fail to achieve the lesson's outcomes. Venkat and Spaull (2015) argue that non-specialist mathematics teachers lack subject content knowledge and appropriate teaching skills. In such a case, it can be described as a chef without a recipe, implying that the intended job cannot be done without the relevant knowledge needed to perform the job or task. Hence, teachers who lack subject content knowledge will encounter challenges in teaching the subject. Machaba (2013, p. 38) concurs by stating that "teachers must know the subject matter in order to teach it effectively and therefore it is important they possess mathematics knowledge". Those with inadequate knowledge will have a limited capacity to explain and present content to learners in a sense-making way (Baumert et al., 2010). Achievement among learners has a positive correlation with the teachers' subject major and pedagogical practice (Blömeke & Olsen, 2019).

In a study conducted by Brown et al. (1999) on how non-specialist student-teachers conceptualise mathematics, the findings revealed that their understandings were strongly affected by their mathematical experiences in schools, where mathematics was often perceived as difficult and threatening. These experiences would translate into teachers' lessons as it would have impacted their identity. To fill in the gap, teachers of other subjects are requested to teach core subjects like mathematics irrespective of their feelings towards the subject, though often they are promised support and training (Crisan & Rodd, 2017). Dibane's (2018) study revealed that non-specialist teaching impacts on effective curriculum implementation. For instance, without a strong mathematical foundation, a lack of specialised training, PCK, MCK and other factors, curriculum implementation is likely to be unsuccessful. Internationally, the Times Educational Supplement, which creates an index of success in appointing a teacher from their jobs portal and survey data, has recorded mathematics as being the most difficult subject to appoint to in each year since its index started in 2011 (TES Global, 2016). Moreover, Sims

(2017) points out that England has had a large shortage of mathematics teachers since the 2012-2013 academic year and even larger during the 2016-2017 academic year. This implies that there is an underlying challenge with the mathematics subject.

It is evident in this section that most non-specialist mathematics teachers do not have adequate subject matter knowledge or the appropriate teaching methodologies to implement the mathematics curriculum effectively. This highlights the gap between specialist mathematics teachers' knowledge and non-specialist mathematics teachers' knowledge. It is also not known whether the Department of Basic Education in South Africa is aware of the impact the placements of non-specialist mathematics teachers at primary schools, particularly the intermediate phase, has on curriculum implementation. However, in light of the findings provided by NEEDU (2012), there is evidence of the impact of non-specialist mathematics teachers, in response to which not much has been done to ameliorate this issue. This is of paramount importance, as it is in this phase of learners' schooling that a concrete mathematical foundation is laid (Dibane, 2018). Consequently, there is a need for non-specialist mathematics teachers to undergo specialised teacher training, with the inclusion of specialised knowledge and methodologies for the effective teaching and learning of mathematics (Bal et al., 2001; Ingersoll, 2001; Van Zoest & Bohl, 2005). The literature has shown the contribution made by non-specialist teachers in different contexts of the world; it has also shown that they are often coerced to take the subject and in other cases where there is no qualified mathematics teacher. After reviewing scholarly works around the topic, the literature indicates that the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase are understudied in South Africa. Therefore, my study seeks to explore the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase, with the hope of understanding their challenges and/or successes, aiming to contribute to existing knowledge, to identify emerging gaps and to understand the phenomenon of non-specialist teachers.

2.6 Conclusion

The chapter has provided an overview of the history and development of the South African schooling system pre- and post-apartheid. The different curricula since 1994 were outlined, namely, OBE, C2005, RNCS, NCS and CAPS. The chapter presented the context within which curriculum change was introduced in South Africa and the impact it had on teachers and

learners. One of the findings worth noting was the lack of literature on the experiences of non-specialist mathematics teachers in implementing the curriculum. In addition, another important factor was the lack of training provided to teachers to implement the curriculum effectively. The chapter thereafter discussed the international literature on education and the literature focusing on the current state of education in South Africa. The idea behind this was to establish an understanding of the existing and emerging trends of literature in relation to the phenomenon. It became evident that South Africa's educational practices differ from those of highly successful countries that performed notably well in benchmarking tests. Also, the chapter outlined the way in which specialist mathematics and non-special mathematics teachers implement the curriculum. Research has highlighted that there are differences in the way a specialist mathematics teacher implements the curriculum in comparison to a non-specialist mathematics teacher. A lack of specialised training and of PCK, MCK and MPK are some of the significant factors contributing to the differences in teaching between a specialist and non-specialist mathematics teacher. In the subsequent chapter the theoretical framework that guides this paper will be discussed.

CHAPTER THREE: THEORETICAL FRAMEWORK

3.1 Introduction

According to Phakisi (2008), a theoretical framework helps guide the researcher in conducting appropriate research as it provides the theoretical underpinnings. It is a lens on which the researcher positions their study (Henning et al., 2004). This study uses Shulmans (1987) model of teacher knowledge to understand and interpret the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase. The model consists of seven knowledge bases. This study's focus will be on what Shulman (1987) explains as the three knowledge types required for teachers of any subject to teach effectively, these being, subject matter content knowledge (SMCK), pedagogical content knowledge (PCK) and curricular knowledge (CK). However, Shulman identified PCK as special interest; it consists of the blending of sound content knowledge and an understanding of pedagogy. The importance of Shulman's model of teacher knowledge for my study is that it forms the basis for understanding and interpreting the experiences acquired from non-specialist Mathematics teachers by identifying their PCK.

3.2 Shulman's model of teacher knowledge

Shulman (1986) identified a blind spot in research conducted on teacher knowledge, relating to subject matter content, how teachers manage their classrooms and organise activities. The missing aspects were questions about the content of the lessons taught, the questions asked, and the explanations offered (Barendsen & Henze, 2017). This brought on his introduction of the concept of PCK, which goes beyond subject matter knowledge but looks at subject matter for teaching. This type of teacher knowledge represents "the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organised, represented and adapted to the diverse interests and abilities of learners and presented for instruction" (Shulman, 1987, p. 8). This definition concludes that PCK looks at teachers' understanding and their enactment to meet the needs of the learners. For these reasons, Shulman's model of teacher knowledge befitting for my study. Using Shulman's work, I will be able to obtain data from teachers regarding their understanding of the curriculum and how they enact it.

Alongside Shulman's recognition of PCK as a necessary knowledge base for effective teaching, similar views were expressed in other educational reform documents, for example, The American Association for the Advancement of Science 1993 and The National Research Council 1996 (Barendsen & Henze, 2017). It has been noted that PCK provides fundamental information about the teacher, specifically on how they teach, the approach chosen, and these reports further reveal that their teaching is dependent on the knowledge they have. In addition, Barendsen and Henze (2017) amalgamate PCK as knowledge-on-action (teachers' content knowledge) and knowledge-in-action (teachers' enactment) and have recognised that the relationship between the two are inherently complex. There are many factors that influence and make this relationship complicated, such as teachers' histories, their beliefs and values, amongst others. Most notably, teachers are no longer viewed as mere technicians of the curriculum but as intellectuals who have the necessary knowledge base to teach (Fernandez, 2014).

PCK is a concept that acts as a mirror of representing teachers' professional knowledge. Professional knowledge encompasses an understanding of teaching techniques, topic representations, student comprehension, scientific procedures, and thought patterns. (Fernandez, 2014). In light of acknowledging teachers as intellectuals, in South Africa, there is still a large cohort of teachers in the education system, albeit closer to retirement, who trained during apartheid in the former colleges of education (Wolhuter, 2006). The number of colleges dramatically decreased after 1994. The Minister of Education at the time, Kader Asmal, stated between July 1999 and July 2000 that he intended to merge all colleges into universities. The intention of the apartheid education system was to produce teachers who will serve as curriculum technicians (Wolhuter, 2006). Post-apartheid universities aim to produce teachers who are intellectuals. Therefore, the existing population of teachers consists of those who were trained during apartheid (colleges) and post-apartheid (universities), this then creates variation between those teachers' knowledge-on-action and their knowledge-in-action. It is more pertinent to identify if this variation is evident in teachers who are teaching outside of their specialisation, especially in core subjects such as mathematics. Identifying their PCK could assist to facilitate the promotion of PCK development in teachers (Fernandez, 2014).

Learning needs to be represented in a way that is comprehensible to others. PCK involves the understanding of what makes learning specific topics easy or difficult, the conceptions and preconceptions that learners bring to the learning of the most taught topics and lessons

(Shulman, 1986). Thus, according to Shulman (1986), PCK consists of the following elements: a) knowledge of routinely taught themes in one's subject area; b) knowledge of forms of expression of those concepts and c) knowledge of students understanding of those issues. Whilst PCK was widely known and used, several research papers such as '*Assessing PCK: a new application of the uncertainty'* (Smith and Banilower, 2015), '*Improving PCK of chemical equilibrium in pre-service teachers'* (Mavhunga and Rollnick, 2013) and *'Explicit inclusion of topic specific knowledge for teaching and the development of PCK in pre-service science teachers'* (Mavhunga, 2012) presented similarities and dissimilarities and new forms of PCK that emerged, resulting in a lack of consensus regarding the nature of PCK and the way it was being used.

However, more recently to address these inconsistencies the researchers and experts of science met first in 2012 and in 2016 where a consensus model and a refined consensus model were developed (Shulman, 2015; Hume et al., 2019). Following this in-depth examination of the above-mentioned related studies, PCK can be defined as the essential professional knowledge base of teachers that exists in both theoretical and practical forms (Barendsen & Henze, 2019). Through PCK, a teacher transforms his or her subject matter understanding and enacts pedagogical reasoning such as guiding lesson planning, instructional strategies, and reflective practice.

Kind (2009) states that for many decades it was believed that teachers only needed to know the specific content, however, this was proven not to be the only requirement for effective teaching. Pedagogy refers to teaching practice, instruction, and teaching procedures (Loughran, 2013). On the other hand, Dibane (2018, p. 24), in the context of mathematics, explains that "The teacher's subject matter knowledge refers to the mastery of the content that the teacher is expected to teach, and the ability to demonstrate knowledge of mathematics content". Hence, both subject matter and pedagogy share a relationship in terms of what the teacher knows and how they will transfer that knowledge to the learners. Venkat and Spaull (2015), in their study of South African mathematics teachers' subject matter knowledge, found that there is a significant issue with primary school mathematics teachers' subject matter knowledge in South Africa. The teachers under study did not possess the required subject matter knowledge, which negatively impacted pedagogy. Dibane (2018) states that the mathematics performance test score of South African mathematics teachers presented in the South African Consortium for Monitoring Educational Quality (SACMEQ) in 2007 revealed that 79% of grade six

mathematics teachers‘ subject matter knowledge was below their grade level. This implies that the teachers were teaching content that they were not familiar with or had no methodology for teaching it. Shulman’s (1987) model of teacher knowledge highlights the importance of teachers having sound subject matter knowledge, as this affects all areas of teaching and learning. Research from the following studies: Thames and Ball (2010), Du Plessis (2013) and Huang and Li (2014), indicates that the subject matter knowledge required for teaching is imperative, but nonetheless insufficient for the effective teaching of mathematics. Following Shulman’s theorising, an effective mathematics teacher requires a combination of subject matter knowledge and teaching skills (pedagogy) (Dibane, 2018). PCK is situated in the middle of the other three knowledge bases for teachers, as it interacts with all of them. Therefore, as Talanquer (2004) argues, teacher training programmes should work towards building the PCK of future teachers.

The process of teaching and learning means the triad: knowledge - teacher - student (Nicu, 2017). On this path, the teacher serves as a link between knowledge and students, i.e. acting as a mediator of learning. Learners can only understand the value of information and transition from the unknown to the known through interactions with the teacher, new subject, or other learners. Nicu (2017) concurs with Shulman’s concept of PCK as she states that only through mastery of pedagogy can effective teaching take place. Teachers must have a thorough understanding of the subject and be adaptable when teaching it. Only in this way will learners be able to develop their own semantic map, travel from one thought to the next, and relate one topic to the next (Nicu, 2017). On this note, it is important, especially for non-specialist teachers, to learn the principles of pedagogy, as mastering pedagogy will allow a teacher to frame a complex academic subject like mathematics to become more comprehensible for students. Hence, it is for this reason this study aims to explore the experiences of non-specialist mathematics teachers in implementing the curriculum.

Furthermore, the medieval view of teaching was that only subject knowledge was required, but social constructivists such as Piaget, Vygotsky and Bruner’s work have led to a more learner-centred approach to teaching that places a greater emphasis on learners’ activities and in which the teacher’s pedagogical skills can actively promote better learning (Brant, 2006). PCK encompasses the following aspects: knowledge of environmental circumstances, knowledge of students, knowledge of pedagogy, and knowledge of subject matter, (Brant, 2006). It is knowledge that has been carefully developed by teachers for the purpose of becoming useful.

A crucial worry for a teacher in the early stages of their career is how to communicate one's own subject knowledge, i.e., how can learners acquire and grasp what the teacher knows and understands. The issue is one of representation: communicating a subject discipline's concepts and processes (Brant, 2006). Shulman (1986) defines representation as the process of transforming subject information into teaching knowledge, which occurs at the nexus of subject knowledge, pedagogy, and knowledge of one's students as learners. In understanding how non-specialist mathematics teachers implement the curriculum, the aspects of representation as identified by Shulman will be useful in determining the way in which they implement the curriculum.

In line with previous studies carried out on the manner in which non-specialist mathematics teachers implement the curriculum, such as those of Feza (2014); Loflin (2016) and Maimela (2015), it has been noted that there are challenges in implementing the curriculum due to the lack of PCK and specialised knowledge. The study will focus on the five transformation processes as highlighted by Shulman, which include: preparation, representation, instructional selections, adaptation, and tailoring of instructions. The first transformation process I want to discuss is: (1) preparation; the study will focus on how non-specialist mathematics teachers analyse and examine resources that will be used to represent their own understanding of the subject matter; (2) representation entails thinking about the main themes of the lesson and coming up with several ways to convey them to learners. Hence the study will look at the way non-specialist mathematics teachers go about representing the themes in meaningful ways to the learners and whether they include analogies, metaphors, examples, tales, and simulations. Brant (2006) argues that these aspects bridge the gap between the teachers' understanding and the learners' understanding. When teachers use a variety of tactics for teaching and learning, such as Socratic discussion, discovery learning, project methods, and learning outside of the classroom, they are referred to as 'instructional selection' (Brant, 2006).

The transformational processes are important for the study as they determine the approach the non-specialist teacher takes when teaching and the reasons thereof. The next transformational process is (3) adaptation. This is equally fundamental as it will identify how non-specialist mathematics teachers adapt the represented content to the qualities of the learners to reflect their learning styles. Finally, the last transformational process is (4) tailoring of instruction, will assist in finding out how non-specialist mathematics teachers tailor their teaching to meet the needs of diverse classes, their dispositions, and their receptivity to learning. Russell and

Shawl (1999) state that teachers' knowledge is personal, context-rich, and elusive. Learning how to create effective representations is, without a doubt, a crucial aspect of becoming an effective educator (Brant, 2006).

Shulman cites several additional knowledge bases that a teacher will need to achieve this transformation (see Figure 2 in the next page). These include knowledge of the curriculum, learners and their characteristics, educational environments, educational aims, purposes, and values, and PCK, followed by content knowledge (CK) and (generic) pedagogical knowledge (PK) (Neumann et al., 2018). The concept of PCK as a core component of teachers' professional knowledge is gaining traction (Berry et al., 2016). A lot of research that was done after Shulman's concepts showed how teachers' content orientations affected the way they taught that particular content. Grossman (1990) demonstrated how teachers' literary perspectives influenced how they engaged with texts together with their learners. According to Wilson and Wineburg (1988), the ways in which social studies teachers depicted historical knowledge for high school learners were influenced by their academic backgrounds in political science, anthropology, and sociology. As such these scholars have identified the importance of PCK amongst teachers and were able to understand the influencing factors that made up teachers' PCK. Figure 2 illustrates the various knowledge types that are required from teachers. The importance of PCK is highlighted by being placed in the middle of the diagram, as all other knowledge types are dependent on PCK.

As stated earlier, Shulman (1987) defines PCK as that distinctive amalgam of subject and pedagogy that is uniquely the province of teachers, their own special form of professional understanding. This entails how knowledge in each domain is organised and tailored to learners varied interests and skills while being taught. Therefore, in the absence of a strong PCK, all other knowledge types will not be achievable. Similarly, other scholars have also identified the importance of PCK being at the centre. For example, according to Bromme (1997), PCK is the knowledge required to convert subject matter content into instructional content. He says that the structure of the subject matter is insufficient to direct instruction design. Finding appropriate subject-matter representations and choosing the order and sequencing of ideas—that is, turning subject-matter structure into an instructional structure require content-specific pedagogical knowledge, which is a fundamental prerequisite. Berry et al. (2016) also agree by claiming that understanding a teacher's PCK gives room to understand what contributes to teachers' knowledge.

Figure 2. Teacher professional knowledge according to Shulman (1987)

Shulman's model of teacher knowledge provides insights into the factors that contribute to teachers' knowledge. My study is predicated on understanding the experiences of non-specialist mathematics teachers. As such, understanding their knowledge base will assist in creating a framework for understanding their experiences. The model highlights the importance of PCK and its relation to the other knowledge types. In this specific study, the focus will be on identifying how non-specialist mathematics teachers transform their subject matter into effective representations to meet the diverse needs of their learners.

3.3 Conclusion

This chapter has discussed the theoretical framework that guides this study, which is Shulman's model of teacher knowledge, specifically focusing on teachers' PCK. In the chapter, I have outlined the significance of the model for the study as it allows the researcher to interpret and understand the experiences of non-specialist mathematics teachers in implementing the mathematics curriculum. It became evident that PCK encompasses the integration of content and pedagogy into an understanding of how certain topics, problems, or situations are organized, represented, and adapted for the learners' various interests as well as skills. This model is pertinent for this study as it aims on identifying the non-specialist mathematics teachers' PCK by interpreting their experiences. The next chapter presents the research methodology chosen for the study.

CHAPTER FOUR: METHODOLOGY

4.1 Introduction

In the previous chapter, I provided a discussion of the theoretical framework that informed the study. In this chapter, I present the research methodology that was employed in conducting the study. Any research study must have a methodology, since it describes how the research was carried out (Creswell, 2014). According to Abu-Taieh et al. (2020) methodology demonstrates the process by which researchers define the problem they are investigating, set their objectives, and present their findings based on the information gathered during the research period. Similarly, Braun and Clarke (2013) define research methodology as the methodological approaches and techniques used by a researcher to accomplish the objectives of the study. The objective of the study was to explore the experiences of non-specialist mathematics teachers based in primary schools in implementing the curriculum. This chapter will firstly discuss the research approach adopted, the research paradigm and the methodology. Thereafter, I will discuss the data generation methods, sampling, and the analysis process. Lastly, I will discuss the researcher's reflexivity, trustworthiness, ethical considerations and the conclusion.

4.2 The research approach

Research approaches consist of plans and procedures for research, which extend from broad assumptions to the following stages: detailed procedures for data generation, analysis and interpretation (Creswell & Creswell, 2018). According to Creswell and Creswell (2018) there are three research approaches, namely, qualitative, quantitative and mixed methods. For this study I adopted a qualitative research approach. The purpose of qualitative research is to study and understand the meaning that different individuals or groups assign to various human or social problems (Creswell & Creswell, 2018). Similarly, Merriam (2009) explains that qualitative researchers are drawn to understanding how people construct their worlds, interpret their experiences, and provide meaning to those experiences. The study aimed to gain a rich understanding of the experiences of non-specialist mathematics teachers in implementing the mathematics curriculum in the intermediate phase; hence this approach was appropriate because it deals with descriptive accounts as well as lived experiences of individuals in a particular context. Qualitative research occurs in natural settings, where human behaviour and

events occur (Creswell, 2014). This natural setting was the teachers' classroom as it was the context in which they implement the mathematics curriculum.

The distinction between qualitative and quantitative research often refers to the use of words (qualitative), rather than numbers (quantitative) (Creswell & Creswell, 2018). The study aimed to collect textual and contextual data instead of numerical, which made it suitable. Ahmad et al. (2019) posit that qualitative research is used to get an in-depth understanding of human behaviour, experience, attitudes, intentions, and motives to discover how people think and feel. Through this approach, the study was able to gain an understanding of how the participants interpret their lived experiences and the connections they share with their context. Qualitative research acknowledges that participants' interpretations are context based (Nieuwenhuis, 2010). Therefore, the study ensured that the phenomenon of interest was understood from the participants' perspective and not the researchers' (Merriam, 2009). Likewise, Ahmad et al. (2019) concur that qualitative research is a type of research where the researcher privileges the participants' experiences. For this study, the participants constructed meanings and interpreted their lived experiences. This research approach enabled an in-depth understanding of the lived experiences of non-specialist mathematics teachers. The next section presents a discussion of the paradigm that informed this study.

4.3 Research paradigm

According to Goduka (2012), a paradigm is the collective set of beliefs, standards, and methods that make up a research community. Guba (1990) uses the term worldview to describe a paradigm, meaning a basic set of ideas that direct action. The study aimed at understanding the experiences of non-specialist mathematics teachers who are located in a particular context; therefore, it was informed by the interpretive paradigm. Bertram and Christiansen (2014, p. 26) make a similar argument; they argue that the purpose of an interpretive paradigm "is to develop a greater understanding of how people make sense of contexts in which they live and work". The interpretive paradigm acknowledges that there are multiple realities, meaning there are many possible interpretations of events, situations and experiences (Guba & Lincoln, 1994). As such, through this paradigm I was seeking to make sense of the subjective world of human experience (Cohen et al., 2011). Stake (1995) argues that subjectivity in the paradigm is not a negative aspect, but it is an important feature of understanding. People have different beliefs

and personal experiences which will create interpretations. Maree (2007) highlights that, as long as those people are the ones who have lived through those experiences, their interpretations are accepted as true. The factor/s that influence a researcher to choose a paradigm for their research are based on their beliefs which action them to make their choices (Creswell, 2013). As Bertram and Christiansen (2014) indicate that a research paradigm is a way of seeing the world that determines what research is appropriate and how it should be conducted for the researchers who subscribe to it. For this reason, it is important for the researcher to also understand and discuss the philosophical assumptions that underpin the study (Creswell, 2013).

In addition to paradigms having their own worldview, they also have their own ontological and epistemological assumptions. According to Creswell (2014), ontology refers to the nature of reality and epistemology refers to how we know what we know. The interpretivist approach is underpinned by a subjectivist ontology, meaning that, as a result of experiences, people form subjective meanings, which are then applied to particular things or objects (Creswell & Creswell, 2018). The paradigm acknowledges that reality is socially constructed. The subjective meanings are not merely imprinted on individuals but are formed through interaction, historical and cultural norms that operate in people's lives and contexts (Creswell, 2014). In terms of the epistemological stance of the paradigm, Maree (2007) advises that researchers should report participants views on a particular subject of research and not impose their own views. This paradigm attempts to gain an understanding of its participants lived experiences. Within this paradigm, "researchers do not aim to predict what people will do but rather to describe and understand how people make sense of their worlds, and how they make meaning of their particular actions" (Bertram & Christiansen, 2014, p. 26). Hence it was suitable for my study as I was attempting to explore and understand the experiences of non-specialist mathematics teachers in the intermediate phase and the way in which they implement the curriculum.

On the other hand, the interpretive paradigm has its own limitations, much as every other research paradigm. Reaching a consensus is difficult in the interpretive paradigm, according to Scotland (2012) and Richards (2003); if reality is subjective and varies from person to person, research participants cannot be expected to reach the same conclusions as some researchers would assume. This shows that, when attempting to reach a conclusion regarding the facts collected, subjective replies may be counterproductive. Also, knowledge through the

interpretive paradigm generally has limited transferability because it may not provide the same results in other situations (Scotland, 2012). Therefore, as a researcher, I was less interested in the participants' unanimity and more interested in the unique teaching styles that each used when implementing the mathematics curriculum as a non-specialist teacher. As a researcher this assisted me to better comprehend the teaching methods that non-specialist teachers employed. Furthermore, because this study cannot be generalised or transferred, I used triangulation (multiple data generation methods) to ensure the study's credibility (I elaborate on this later in the chapter). Also, I appreciated the diversity of ideas, identities and knowledge because of their value for learning and new insights.

4.4 Location of the study

This study is located within the province of KwaZulu-Natal in South Africa. It is in the southeast of South Africa. The capital of KwaZulu-Natal is Pietermaritzburg. KwaZulu-Natal is made up of 43 cities/towns and is known as the Kingdom of the Zulu nation as it is the melting pot of African, European and Indian cultures (City-facts, 2019). KwaZulu-Natal has an estimated population of 3 720 953 (Statistics South Africa, 2021). The area in which the study was conducted was in Tongaat, on the north coast of the province. The estimated population of Tongaat is 42 554 (City-facts, 2019). Tongaat was established in 1945 and its name is derived from the uThongathi river which passes by the town. The population of Tongaat is mostly people of Indian descent. The area is mainly dominated by the agriculture industry. The town is also one of the largest sugar-producing districts in the world, with one of it being the home to the headquarters of Tongaat Hulett Sugar.

The non-specialist mathematics teachers consisted of both male and female teachers, and all were of Indian descent. Most of the teachers live nearby their respective schools and a few further away. All the participants were not born and brought up in the area but are now residing in the area due to reasons of employment. The learner population in the chosen schools were made of 95% African descent.

Figure 3 below depicts the nine provinces of South Africa with the highlighted area showing the location of KwaZulu-Natal on the map. Figure 4 illustrates the cities/towns that make up

KwaZulu-Natal. The objective of including these maps is to display the geographical position of the province and where the participants originate from.

Figure 3 Map of South Africa (Menhard, 2019)

Figure 4 Map of KwaZulu-Natal province (Sa-venues, 2013)

4.5 Research methodology

I begin this section by clarifying the distinction between methodology and methods, as both serve different purposes. According to Cohen et al. (2018), methodology refers to how a researcher attempts to find out about the phenomenon and methods refer to instrumentation,

which is how the data will be generated and analysed. Methodology provides the justification for the choice of methods used. Since the study was underpinned by the interpretivist paradigm and aimed to understand the experiences of non-specialist mathematics teachers in implementing the curriculum in a specific context, a case study methodology was an appropriate choice for the study.

4.5.1 *Case study methodology*

Yazan (2015) argues that a case study has multiple definitions and as such has been considered a 'contested terrain'. One of the pioneers of case study research methodology, Yin (2014, p. 16) defines a case study as an "empirical inquiry that investigates a contemporary phenomenon within its real-life context". As such the contemporary phenomenon that was explored in the study was the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase. Moreover, a case study enables the researcher to study the participants in their real-life context, which is their classrooms in this case (Baxter & Jack, 2008). Maree (2007) believes that the primary strength of a case study methodology is its use of diverse data generation sources (triangulation), particularly when the goal is to gather rich data and a thorough understanding of the topic being studied. Therefore, I used multiple data generation methods with the intention of eliciting rich data from the participants.

A case study is a systematic and in-depth study of a particular case in its context (Rule & John, 2011). The case in this study are non-specialist mathematics teachers in their classrooms. Case studies are descriptive in nature as they aim to describe 'what it is like' to be in a particular situation. Likewise, Cohen et al. (2000) state that the researcher aims to capture the reality of the participants in their context. Case studies can also establish cause and effect ('how' and 'why' questions) (Cohen et al., 2018). The study's research questions are consistent with this view, which therefore made the methodology appropriate. Case study methodology can be grouped into two types: a single case study and multiple case studies (Stake, 1995 & Yin, 2009). In a single case study, there is one issue in one case within a bounded system chosen by the researcher. Herein the bounded system is the Tongaat context in which the non-specialist mathematics teachers work. On the other hand, in multiple case studies, one issue is chosen by the researcher and explored across all the cases – for example, researching the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase

in all areas of South Africa with the different areas forming the cases. The study, therefore, utilised a single case study as the focus was on the experiences of non-specialist mathematics teachers in the intermediate phase within the context of the Tongaat area. There are also intrinsic or exploratory case studies. Intrinsic case studies are studies that are conducted to understand a particular case in question whereas exploratory case studies are used to generate hypotheses that can be tested in large-scale surveys or in other forms of research (Cohen et al., 2018). I therefore categorised the study under the intrinsic case study, since it looked at a particular case. Which is the case of non-specialist mathematics teachers.

4.5.2 *Sampling*

Sampling refers to the decisions made around which people, settings or events to include in a study. There are two dominant methods of sampling; random sampling (also referred to as probability sampling) and purposive sampling (referred to as non-probability sampling. Random sampling implies that every individual of the population has an equal chance of being included in the sample (Bertram & Christiansen, 2014). Purposive sampling indicates specific choices made by the researcher about which people to include in the sample (Bertram & Christiansen, 2014). As the word 'purposive' stipulates, the sample is chosen for a specific purpose. Therefore, this study used the purposive and convenient sampling techniques to recruit participants. Most often sampling in qualitative research is not random, but mostly purposeful and generally comprises of a small sample size, as researchers are expected to spend a decent amount of time in a natural context (Flick, 2007 & Merriam, 2009). Researchers may collect photos, words and conduct observations and interviews which are later transcribed into text and analysed. Participants were chosen based on the fact that they had to be a non-specialist mathematics teacher and be teaching in the intermediate phase in a Tongaat-based school. In the schools that I approached I was directed to teachers of Indian descent as the area consisted predominantly of this race group and they were the non-specialist mathematics teachers at the schools. Therefore, my sample consists of only people of Indian descent. This study used purposive sampling as it enabled me to obtain a sample that met my specific needs which was non-specialist mathematics teachers teaching in the intermediate phase.

Additionally, Merriam (2009) states that it is imperative that the criteria used to recruit participants reflect the purpose of the study. The recruitment of participants for this study was

selected using the purposive sampling technique, specifically looking at non-specialist mathematics teachers in the intermediate phase. To recruit the participants, I approached gatekeepers such as the principals seeking permission to conduct research. I ensured that the study is as transparent as possible, and that anonymity and all other ethical considerations were in place. In addition, the results yielded from this study do not seek to generalise to the wider population. I approached five different schools and had a total of seven participants. Two schools had two teachers each whereas the other three schools consisted of one teacher. Although the focus was on teachers who taught in the intermediate phase (grades 4-6), I decided to include the grade 7 teachers as participants because grade 7 is an exit grade in primary schools. This was primarily to understand how they implement the curriculum amidst changes in the grade 7 mathematics curriculum. One such example is the instructional time, with the intermediate phase having 6 hours of mathematics and the senior phase 4.5 hours (DBE, 2011). The table below displays the profiles of the participants who participated in the study.

Number	**Pseudonym**	**Age**	**Grade**	**Gender**	**Teaching experience**	**Specialisation**
1	Kayla	35	7	Female	16	Social Science
2	Ariel	28	6	Female	3	Business Management
3	Adrian	24	6	Male	3	Natural Science
4	Lia	46	5	Female	25	English & Natural science
5	Eva	44	4	Female	20	Psychology
6	Mike	47	7	Male	25	Social Science
7	Lita	47	5	Female	10	English & Natural Science

Table 1 Participants' profiles

4.5.3 *Data generation methods*

According to Bertram and Christiansen (2014, p. 71) "data refer to the evidence or information that researchers collect in order to find answers to the particular questions they are asking". There are several data generation methods, such as questionnaires, tests, secondary data, and interviews, amongst others. This study will use two methods of data generation. The first method is a semi-structured interview. According to Cohen et al. (2018) the topics and questions are predetermined in a semi-structured interview, but they are open-ended, and the

language and order may be tailored for each interviewee as well as the responses provided, using prompts and probes. By having open-ended questions, it enables the interviewer to go into depth.

The concept of prompts and probes under this data generation method allows clarification of questions and it allows the researcher to ask the participants to expand or elaborate, thereby addressing richness and depth (Cohen et al., 2018). Non-specialist mathematics teachers or I (as a researcher) can seek clarity on questions or responses that we do not understand during the interview. Semi-structured interviews have the advantage of making participants feel comfortable as they are not responding to a tight interview schedule. The choice of semi-structured interviews over structured ones was because structured interviews have a few drawbacks, for instance, the tendency to focus the research too narrowly or to overlook equally significant concerns. Therefore, semi-structured interviews were a suitable choice for the study.

The interaction with the participants consisted of two semi-structured interviews and the observation session. Each interview was of 1-hour duration per interviewee. The first interview served as an introductory interview, outlining the purpose of the interview and to create rapport with the participants. The second interview was used to generate data following the pre-set interview questions and prompts. The interview schedule with the questions that were used to generate data is attached as an appendix. An audio-recording device was used to record the interviews to ensure that there was accuracy in the data analysis stage. According to Creswell (2013), the location chosen for the interview should be peaceful and free from any outside distractions. The interviews were conducted according to the respective teacher's availability and choice of time and place. Most of the teachers opted for the interview to take place during their lunch breaks which was of one hour duration. The other few teachers opted for it to take place during their non-teaching period which was also of one hour duration. Through this arrangement I also ensured that teaching and learning as well as other school operations were not interrupted. The interviews took place in spaces that the interviewees were most comfortable and felt that they had enough privacy, such as offices, spare classrooms, and the library.

When I conducted data generation, I started with the first interview which was about establishing rapport and introducing myself to the participants. Days later I scheduled a time with the participants to conduct the classroom observation and the second session of semi-

structured interviews. Due to reasons amongst others the availability of the participants, time and leave constraints as a researcher I had to conduct both the observation and semi-structured interviews on the same day. A regular day at school where teaching begins is from 7:30 am to 14:00 pm. To generate data, I required four hours for two teachers in one day. This was planned by working according to the participants' teaching timetable. While one participant may have been teaching another subject, I was either interviewing or observing the other. This is how I managed to conduct both interviews and observations in one day. I decided to start with the observations as most schools have mathematics during the morning session. The interviews were then planned according to the availability of the participants on the day.

Bertram and Christiansen (2014) warn about how power dynamics can affect the interview process during the data generation process; therefore, researchers must consider how their position may affect the participants. The interviews (as mentioned above) were utilised to address the power dynamics between the researcher and participants, and participants were interviewed in a setting that made them feel at ease. Through the interview conversations, the issue of power dynamics was eliminated, as a rapport between me and the participants was created, thus making the participants feel safe and comfortable. I also explained to the participants that they had the liberty to stop me at any point for a short break session or if they needed to withdraw.

The second method of data generation for the study was a semi-structured observation. As indicated earlier, the semi-structured interview (second visit) and the semi-structured observation were conducted on the same day. Swanborn (2010) points out that observation is a crucial component of a case study research. Observations provide a chance of learning things that participants may be unwilling to discuss in an interview. A semi-structured observation has an agenda of issues but accumulates data to illuminate these issues in a far less predetermined or systematic manner (Cohen et al., 2018). The purpose of observation is to shed light on the context by relaying information about behaviour, performance and incidents that can be further explored in the subsequent interviews (Merriam, 2009). The observation took place during the teachers' mathematics lesson and lasted for about 45 minutes to an hour. The observation schedule with the information that guided me during the teachers' lessons is attached as an appendix. The purpose of the observation was to explore how the teachers implemented the mathematics curriculum as a non-specialist teacher. Therefore, the focus was on the teachers' teaching styles, type of resources used, the ethos of the class and interaction with the learners. Although many research studies (Adler, 1994; Hofmeyr & Hall 1995; Feza

2014; Maimela, 2015; Venkat & Spaull, 2015) reveal that non-specialist mathematics teachers lack subject matter knowledge, my research was seeking to understand through an in-depth approach different aspects affecting their teaching of mathematics.

At the time of conceptualising my research, the world was facing a pandemic which was Covid-19, and this impacted on research studies. I complied with all protocols and regulations. The interviews and observations only took place by following the measures put in place to minimise the risk of infection such as maintaining social distancing and wearing of masks. Moreover, the interviews and observations took place when the country's alert level was between level one and three. Also, this was consistent with rules and regulations of my institutional research and ethics committee. The table below provides the details of the observations and interviews that took place.

Number	**Pseudonym**	**Date**	**Observation time**	**Interview time**
1	Kayla	09/02/2022	08:30am	10:00am
2	Ariel	09/02/2022	11:00am	12:45pm
3	Adrian	10/02/2022	09:00am	10:30am
4	Lia	10/02/2022	11:30am	13:00pm
5	Eva	15/02/2022	08:30am	10:00am
6	Mike	23/02/2022	11:45am	13:00pm
7	Lita	24/02/2022	09:30am	11:00am

Table 2 Observation and second interview date, time and duration

4.6 Ethical issues

Cohen et al. (2018) describe ethics in research as what a researcher ought and ought not to do in their research. Furthermore, Cohen et al. (2018) highlights that educational researchers must be aware of the effects of their research on participants and have the responsibility to act in a manner that preserves the dignity of the participants as human beings. For this reason, non-maleficence was considered by carefully thinking out the possible consequences of the study. Before contacting the participants, official permission was sought in the form of writing to the gatekeepers (Department of Basic Education, school principals) and, later on, ethical clearance was granted by my institution, the University of KwaZulu-Natal Research Office. The gatekeeper's letter of permission described the study in full and requested permission to carry

out research in the school premises from the principal. When I wrote to the principals, I attached a copy of the approval letter from the Department of Education to alert the principals that the necessary protocols were followed. The principals granted me permission to conduct the study and confirmed that the school, could have potential participants matching my criteria.

As the researcher I made sure to get informed consent from the participants before proceeding with the research. Attached to the consent form was the ethical clearance and the letter of permission from the KwaZulu-Natal provincial Department of Education. This was to assure the participants that the whole process is legal and is recognised by the relevant institutions. Producing the documents and explanations to the participants assisted in gaining their trust. The participants were made aware of the purpose of the study, and they were informed that participation is voluntary and it is acceptable to withdraw at any given time, should they feel uncomfortable (Howe & Moses, 1999). Participants were also notified prior to the research that anonymity will be addressed by ensuring confidentiality of their identities. I informed the participants that each will be allocated a pseudonym and the documents containing any information that may describe them will be kept safe and confidential. Cooper and Schindler (2001, p. 17) suggest that "confidentiality can be protected by obtaining signed statements indicating non-disclosure of the research". For this reason, before the research was conducted, I stipulated what information will be required from the participants and the purpose (i.e. for educational purposes only).

4.7 Trustworthiness

In qualitative research, the idea of trustworthiness, which encompasses dependability, confirmability, and credibility is utilized in place of the concept of validity (Shenton, 2004). Trustworthiness is a concept used by Lincoln and Guba (1985) for qualitative research. This study is premised under the qualitative approach and interpretivist paradigm. Bertram and Christiansen (2014, p. 188) state that trustworthiness is "using the concepts of credibility (do the findings reflect the reality and lived experiences of the participants?), transferability (to what extent can the research be transferred to another context?), dependability and confirmability".

4.7.1 Credibility

Credibility identifies whether the researcher has represented the participants' original data in a plausible and authentic manner (Lincoln & Guba, 1985). To enhance the credibility of the research, data collection comprised using two data generation methods with seven teachers from different schools. This is called triangulation, where data is generated from several different sources (Bertram & Christiansen, 2014). The findings from the study were analysed based on the audio-recordings and transcripts from the semi-structured interviews, and field notes from the semi-structured observations. Nieuwenhuis (2010) indicates that to ensure credibility, member checking should be done. This is whereby the participants are given the transcripts to correct any errors of fact. Thus, after the process of transcription I gave my participants the transcripts to read and check if the transcripts represent their original views. All the participants confirmed that the transcripts were correct and a true reflection of their views.

4.7.2 Confirmability

Lincoln and Guba (1985) state that confirmability establishes that the data and interpretations of the findings are not figments of the researcher's imagination but are true interpretations. To ensure the research is true and authentic and reflects exactly the participants' views, the research process was made transparent, with sufficient details and steps that led to a conclusion. As an intermediate phase teacher, myself, I have made sure I am aware of my own positioning and how my beliefs and experiences can influence the views of my participants. In ensuring that I avoid bias I have written a researcher reflexive section detailing the data generation process, my positioning and privileges, and how I navigated the challenges in this research.

4.7.3 Dependability

According to Bertram and Christiansen (2014, p. 190) dependability refers to "when the researcher can account for why there may be variations in the study, for instance between cases". Dependability was ensured by making comparisons to this study with previous studies undertaken on this topic, at the same time highlighting key differences such as resources, facilities and amongst others. Shenton (2004) encourages researchers to provide reports that

are detailed to enable future researchers to repeat the work if necessary. The study has outlined the research design and its implementation, how the research was conducted in the field and lastly, reflecting on the process of the inquiry undertaken. The research processes were made transparent through the use of a reflexive journal.

4.7.4 Transferability

Transferability is the degree to which the results of the study can be transferred to other contexts or settings with other participants (Lincoln & Guba, 1985). I have therefore provided thick descriptions of the experiences of the participants, research context and the research design to address the issue of transferability. However, the purpose of the study was not to generalise the findings as it consists of a small sample size and peoples' lived experiences cannot be generalised.

4.8 Researcher reflexivity

Positionality refers to both a person's worldview and the stance they take on a research topic and its social and political context (Foote & Bartell, 2011). Individuals' worldview consists of ontological assumptions, epistemological assumptions and assumptions about human nature (Scotland, 2012). It influences the methods used in research as well as the conclusions drawn from it (Rowe, 2014). For the researcher to be able to identify, construct, critique, and articulate their positionality, self-reflection and a reflective methodology are both essential prerequisites (Holmes, 2020). Basically, reflexivity informs positionality. Reflexivity is the idea that researchers must acknowledge and disclose themselves in their research while attempting to understand how they contributed to or influenced the research process (Cohen et al., 2011). Reflexivity's primary objective is to mitigate the possibility of bias among researchers. In turn, this increases the study's credibility for purposes of trustworthiness (Palaganas et al., 2017).

During the study, and in keeping with the reflexive process, I kept a diary in which I jotted down notes about the participants' comments and my own feelings and thoughts during the interviews. In addition to writing notes, I also went through the transcripts and listened to the audio recordings multiple times to ensure I gathered a clear and true understanding of what was said by the participants. Whilst reading the transcripts and listening to the recordings I reflected

on key issues by writing down thoughts on my own background and position to identify how they influenced the research process. This process assisted in identifying my position and being able to disclose it in the study, aiming to reduce researcher bias. To begin the discussion on reflexivity, I will start with my personal background and on being a non-specialist mathematics teacher. Thereafter, I will present the challenges that I encountered in finding relevant literature. I will then discuss the research approach and methodology as well as the selection of data generation methods.

4.8.1 Personal background

I am an Indian female who is in her late twenties from a middle-class family. I am from a small town called Verulam located in KwaZulu-Natal (KZN) province, South Africa. I studied at the University of KwaZulu-Natal Edgewood Campus (UKZN) and have obtained my Bachelor of Education and Honours degree at this institution. I have been teaching for six years in four different primary schools. From a young age, I have always had a passion for teaching and a love for imparting knowledge. I have specialised in Natural Sciences and Life Orientation. However, I currently teach mathematics. It is for this reason that the intention of this study was to explore the experiences of other non-specialist mathematics teachers located in primary schools to understand the ways in which they implement the curriculum.

4.8.2 Being a non-specialist mathematics teacher

Before entering the research site (schools), the teachers and school management teams had already known briefly about me such as my name, gender, and occupation. This information was provided in the permission documents that I had given to the principals. Upon approaching the principals, I was given the impression that they perceived me as a young teacher who is doing Masters. I was offered warm beverages and I found that to be very welcoming. Most of the principals commended me on furthering my studies at an early age and encouraged me to continue studying further. One of the principals alerted me that he completed his Masters and he provided advice on how to go about approaching the data generation process which was very helpful. I also found that all of the principals were males, and I initially felt intimidated because I am a female and had thought that they may not understand me or take me seriously. However, after meeting and interacting with them, I felt comfortable and welcomed.

After interacting with the principals, they took me to meet the teachers and I found that the majority of the teachers were older than me and had many years of teaching experience. The age gap had already created a comfortable space for the teachers. I could see the relief on their faces as they looked at me as someone who is younger than them and therefore did not pose as a form of intimidation. Most of the teachers indicated that they expected a much older person and joked about it. After explaining the purpose of my visit and study, one of the things I picked was the fear the teachers displayed. The fear stemmed from them thinking that their identity will be known to everyone reading my study. I assured the teachers that their identities will remain confidential and that they are not compelled to speak about anything that makes them feel uncomfortable. The teachers felt comfortable interacting with me after knowing my position, which is a grade 4 non-specialist mathematics teacher. My position and being in one of the neighbouring schools made it easier for the teachers to trust me. Despite the teachers and School Management Teams viewing me as a young researcher and teacher, they respected my academic standing and created a conducive environment.

As indicated earlier I have six years of teaching experience. During my first two years of teaching, I experienced a number of challenges relating to curriculum implementation and lesson delivery. These challenges stemmed from firstly teaching mathematics as a non-specialist and being unfamiliar with the mathematics curriculum. I had to seek assistance from other sources such as the Internet and textbooks and engage in self-teaching to ensure I taught the subject correctly. The reason behind opting for self-teaching and seeking assistance from the internet was caused by the lack of support and training provided by school managers and curriculum advisors. I was therefore interested in understanding other non-specialist mathematics teachers' experiences, particularly on how they implement the curriculum. The selection of participants and of the focus of my study was influenced by my experiences as a non-specialist mathematics teacher. My experience as a non-specialist mathematics teacher gave me advantages in engaging with the participants, as I was able to easily communicate and relate to them because I shared similar if not the same experiences. In the next section I will discuss the challenges I experienced in finding relevant literature.

4.8.3 Challenges in finding relevant literature

Upon researching other studies on the experiences of non-specialist teachers I found that this topic of interest was under-researched. I reviewed literature both nationally and internationally.

Whilst there were a few studies done internationally, it was difficult to find literature locally. Most of the literature conducted locally, focused on the challenges of teaching mathematics and the poor pass rate in mathematics. The literature that I did find was reviewed and presented in chapter two.

4.8.4 The research approach and methodology

In this study, I used the qualitative research approach as I attempted to understand the meanings the participants assign to their experiences (Creswell & Creswell, 2018). Since the study aimed at understanding the experiences of non-specialist mathematics teachers, the study adopted the interpretive paradigm. As Guba and Lincoln (1994) indicate, this paradigm acknowledges that there are multiple realities, meaning there are many possible interpretations of events and experiences. On this note, the paradigm aims to make sense of the subjective world of human experience (Cohen et al., 2011). The methodology that was suitable for this study was case study methodology as with this methodology the researcher aims to capture the lived experiences of the participants in their context (Cohen at al., 2000). Similarly, the study aimed at capturing and understanding the lived experiences of the participants in their classrooms (context). The next section will present the data generation methods chosen for the study.

4.8.5 The data generation methods

Data was generated using semi-structured interviews and observations. The choice of methods was most suitable for the objectives of this study. Semi-structured interviews enabled the interviewer to go in-depth and obtain thick descriptions using prompts and probes. The second data generation method, which was observation, enabled me to understand how they implement the curriculum, their respective teaching styles and how they respond to learners' misconceptions; it was also used as a tool to verify what they said during the interviews. Both data generation methods allowed the study to gather in-depth information regarding the experiences of the participants. The following section presents my experiences of analysing the data.

4.8.6 My experiences of analysing the data

In analysing the data, the study followed both the deductive and inductive approaches. The choice for these data analysis approaches stems from the study's research methodology. Whilst

analysing the data I was aware of how my background and position might affect the data analysis process. As a result, I constantly ensured that I read and re-read the research questions and reminded myself of the objectives and focus of the study. This process allowed me to remain on track and avoid possible biases. My meetings with my supervisor also assisted in clarifying challenges that I encountered and provided guidance and support. The meetings with my supervisor also enabled me to keep a neutral position by maintaining my focus and position in the study.

4. 9 Data analysis methods

In qualitative data analysis there are two broad approaches. The first is an inductive process of analysing the data into categories and then identifying patterns that emerge from the data. The other is a deductive approach that begins with the set categories (Bertram & Christiansen, 2014). The study followed both approaches, the deductive approach and the inductive approach. Deduction is the process of going from the general to the specific, which involves starting with a theory, drawing hypotheses from it, testing those hypotheses, and then updating the theory. On the other hand, induction entails moving from the specific to the broad, like when making empirical observations about an interesting phenomenon and developing conceptions and theories based on them (Locke, 2007). Using the deductive approach, set categories were set and the inductive approach was used to organise the categories and identify patterns in the data. Miles and Huberman (1994) highlight that data analysis consists of three flows of activity: data reduction, data display and conclusion drawing and verification. The three flows of activity are embedded in the analysis method I used, i.e., thematic analysis.

The practice of finding patterns or themes in qualitative data is known as thematic analysis (Maguire & Delahunt, 2017). It is the first qualitative method that should be learned, according to Braun and Clarke (2006), because it provides important skills that will be valuable for undertaking all other kinds of analysis methods. In several paradigmatic or epistemological orientations, thematic analysis is a powerful yet adaptable technique for examining qualitative data (Kiger & Varpio, 2020). However, according to Attride-Stirling (2001) and Braun and Clarke (2006), the analytical procedure and the theories or underlying epistemological assumptions are frequently not described by researchers using thematic analysis. Therefore, Kiger and Varpio (2020) state that, given the adaptability of thematic analysis, researchers who

use this approach must explicitly state their paradigmatic orientations and premises to assure the trustworthiness of their findings and interpretations.

The study used the method of thematic analysis to search for categories and later themes from the data. According to Braun and Clarke (2006), thematic analysis is a useful research tool that is flexible and provides a rich and detailed account of the data. Two methods of data analysis are used in thematic analysis: latent and semantic approaches. Both approaches entail interpretative work since the latent approach looks for and identifies themes within a single participant while the semantic approach looks for patterns across all participants (Braun & Clarke, 2006). Thematic analysis also focuses on information that reflects people's interpretations, meanings, constructions, and assumptions. This approach is crucial because it recognises that people have different realities. It also helps us grasp the themes that emerge from each participant and establish a pattern. This study used Braun and Clarke's (2006) six-stages of thematic analysis to analyse and interpret the themes from a data set. The diagram below illustrates the six-stages of thematic analysis from Braun and Clarke (2006).

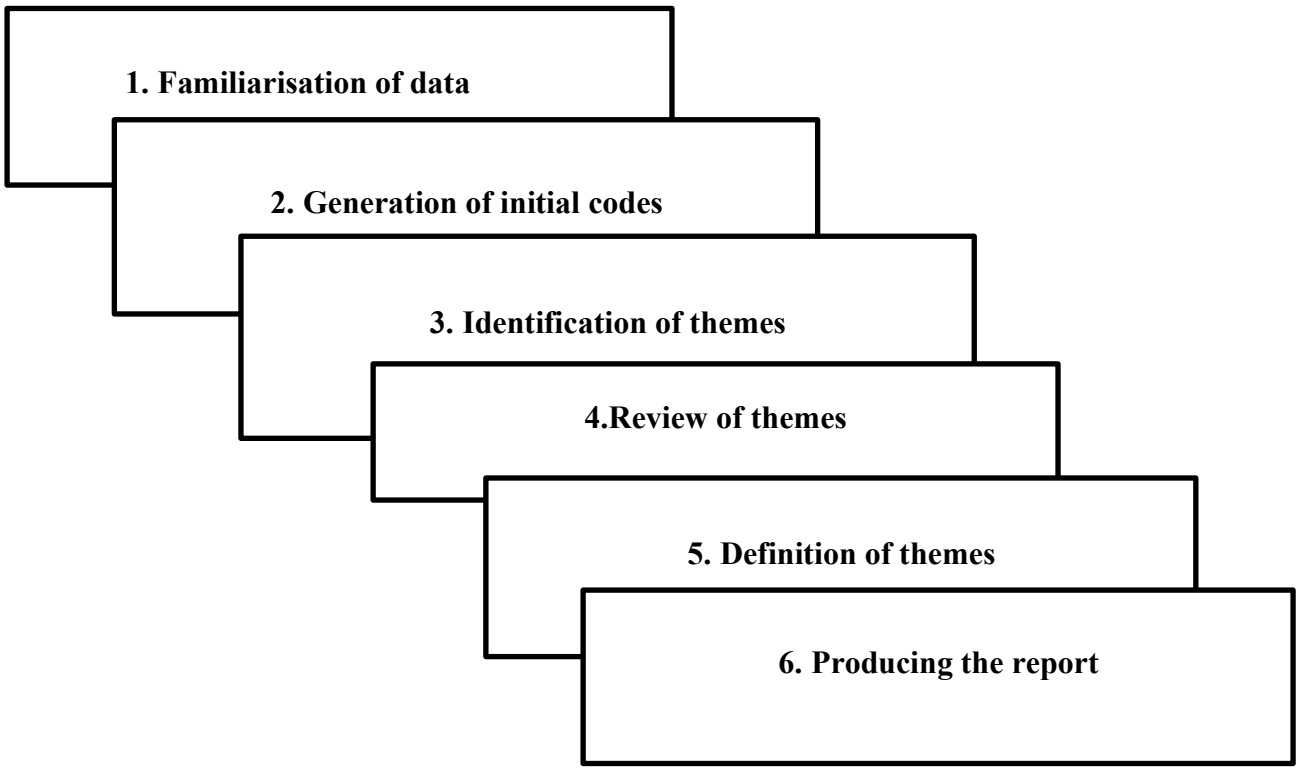

Figure 5 The six stages of thematic analysis

It was very important that as a researcher I familiarised myself with the work of Braun and Clarke (2006), as these six stages were fundamental in interpreting the data that were gathered

from the participants. It is important to note that the numbering on the diagram above is not indicative of the direction one should follow, thematic analysis is not a linear process but rather can follow a back-and-forth process (Braun & Clarke, 2006).

4.9.1 Stage 1: Familiarisation of data

According to Braun and Clarke (2006), it is crucial that you become so immersed in the information that you are familiar with its depth and breadth. Immersion typically entails 'repeated reading' of the data and actively interpreting the data by looking for patterns, interpretations, and other things. Firstly, I gathered all the audio-recordings and I listened to them twice then transcribed to text. I thereafter re-listened to the audio-recordings against the transcripts to ensure that I have transcribed the data accurately and had not left out any important information. While transcription may seem tedious, time-consuming, and perhaps monotonous, it is actually an excellent tool to become familiar with the data (Riessman, 1993). During the analysis of observational data, I compared the contextual aspects such as the classroom settings of the different participants, the use of teacher aids and learner interaction before arriving at conclusions. I also looked for patterns amongst the participants teaching approaches (learner centred or teacher centred) to identify if there are similarities or differences between them. I also read the field notes that I made and tried to make connections between with my checklist, the transcripts, and the observational data. Thereafter, I organised the data in a meaningful way, whilst doing this I had my research questions in mind.

4.9.2 Stage 2: Generation of initial codes

In order to arrange your data into meaningful groupings, the process of coding falls within the category of analysis (Miles & Huberman, 1994). Large amounts of data are broken down into manageable units through coding (Maguire & Delahunt, 2017). I read through each transcript, coding each segment of the text. I did this by hand, working through each transcript with a highlighter. I followed the same approach for the field notes made during the observations. After this process, I needed to identify the themes that emerged which is discussed in the next section.

4.9.3 Stage 3: Identification of themes

A theme is a pattern that encapsulates a key or intriguing aspect of the data and/or research issue (Maguire & Delahunt, 2017). According to Braun and Clarke (2006), there are no set criteria for what constitutes a theme. In stage 3 of the thematic analysis, after analysing the codes there were several themes that emerged, for example, most of the participants stated that they received limited to no training. These codes were collated into a theme as well as sub-themes.

4.9.4 Stage 4: Review of themes

In this stage, the themes are reviewed, modified, and refined (Braun & Clarke, 2006). After identifying the themes that emerged from the data, I went over them repeatedly to ensure that they made sense, and this was done by sorting each theme into its own category.

4.9.5 Stage 5: Definition of themes

The goal of this last stage of the themes is to identify the 'essence' of what each theme is about (Braun & Clarke, 2006). Each theme was defined and given names. I read the data associated with each theme and identified if the data really did support it. Thereafter, I homed in on the most important aspects of each theme and created a narrative of how and why the coded data related to a theme.

4.9.6 Stage 6: Producing the report

This is the last stage in the thematic process. I did a final write-up in the form of a report outlining the themes that emerged and a discussion was presented. This is evident in the next chapter.

4.10 Conclusion

The chapter has presented a discussion of the research methodology that was used in the study. I proceeded to provide a detailed descriptions of the research approach, paradigm, methodology, location, and data generation methods. The chapter also presented the data analysis, researchers' reflexivity, trustworthiness and ethical considerations. In the next chapter I present and discuss the data.

CHAPTER FIVE: DATA ANALYSIS AND FINDINGS

5.1 Introduction

In the previous chapter, I discussed the research design and methodology underpinning this study. In this chapter, the results from the data analysis will be presented in the form of themes. Data was generated from two methods, namely interviews and observations. The chapter will present data from both methods. The study aimed at exploring the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase. Seven participants from schools in Tongaat were interviewed and observed. The participants were allocated pseudonyms to protect their identities and to comply with ethical requirements. Four themes emerged from the findings namely, theme one: becoming a teacher, theme two: teachers' curricular knowledge, theme three: challenges in teaching mathematics and theme four: teachers' future plans. The four themes contain subthemes, which are also presented and discussed where necessary. The research questions for this study are:

1. What are the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools?
2. How do non-specialist mathematics teachers implement the curriculum in the intermediate phase at Tongaat schools?

5.2 Theme One: Becoming a teacher

There are several reasons one may choose to become a teacher. This theme provides insight into the different reasons the participants chose to enter the teaching profession and how those reasons are said to affect their motivation and performance in teaching. Literature has shown that factors such as passion, motivation, and enthusiasm in teachers contribute significantly to effective teaching (Zehm & Kottler, 1993; Zhang, 2014; Serin, 2017; Noor et al., 2021). In this regard, the significance of the theme is that it contributes to an understanding of the teacher as an individual. One can learn how their perceptions of teaching influence their performance as a teacher. That is, whether the participants have chosen to become teachers because they have a passion or are intrinsically motivated. According to Shulman (1986), it is important to understand teachers' knowledge base and how it translates into their teaching practice. The need of knowing one's own educational philosophy is acknowledged by Bigge and Shermis (1999), in addition to being meta-cognitive about teaching practice. By noting that the ways in

which a teacher creates instructional approaches depends on how that teacher understands the learning process. Bigge and Shermis (1999) suggest that teaching is enhanced and learning is improved if teachers are thinking about their teaching philosophy. In a similar vein, Good and Brophy (1997) contend that teachers must comprehend the knowledge base that supports teaching in order to become active decision-makers and to develop their own personal styles, including knowledge not only about instructional strategies but also about learner development, learning, and motivation. The level of learning that learners can achieve in the classroom can be greatly influenced by a teacher's enthusiasm. Less passionate teachers frequently set lower standards for their learners, but more enthusiastic teachers frequently go above and beyond any expectations the learners may have had (Tran & Le, 2022). Learners' curiosity is piqued by this enthusiasm, which motivates them to learn and improves their conduct and test results. Therefore, finding out the reasons behind the participants' choosing to teach has allowed me to understand their teaching philosophy and what constitutes their knowledge base.

5.2.1 Teacher's motivation in choosing teaching as a profession

This theme provides data regarding the reasons teachers choose teaching as a profession. To understand the reasons, I will focus on the three motivational factors that are said to motivate people to choose teaching as a career. These are extrinsic, intrinsic, and altruistic drivers (Balyer & Özcan, 2014). Extrinsic drives include all elements connected to the outside world, such as pay, status, and working circumstances. All the elements closely linked to one's love and passion for teaching which ultimately results in content knowledge and expertise are referred to as intrinsic drivers. Knowing the value and honour of teaching as a noble vocation and having an interest in children's growth and support in contributing to society are two examples of altruistic drivers (Noor et al., 2021). As Clandinin and Huber (2005, p. 43) stress, "teachers teach who they are". That being the case it was important to recognise the participant's choices for entering the profession as it provides insight into what shapes their experiences. It became evident from the participant's responses that most of them chose to teach due to extrinsic factors. Participants described the following as reasons why they chose to teach:

> "*I became a teacher only because it was most convenient for my lifestyle.*" (*Kayla*)

"*Er okay, yeah so teaching wasn't my first choice I wanted to do something in business management but then I didn't get a space actually I did get a space, but it was too far to travel from Stanger to DUT and back. I didn't want to do that so that's when I said let me do teaching. So, I applied for teaching, and I got accepted.*" (*Ariel)*

"*Teaching wasn't my first choice. I studied music and then I realised that there isn't much scope for a music person in South Africa. So, I then decided to study teaching." (Lia)*

"*I wanted to be a child psychologist. I wanted to work with children. I just love children and then when I did my degree, my dad has two relatives who are psychologists, and they were telling him about how long it takes and you only allowed to practice at a certain age about 28 or so, and then I was thinking about what I would do in the interim. So then I looked at some of my friends who were in the teaching profession and my dad's friend was a principal and then he told me to just try out teaching for the time being and because I enjoyed it, it just took me one year (PGCE) and then I became a teacher." (Eva)*

"*Teaching was not my first choice. I was a financial manager for a hospital and working as a financial manager in a hospital meant spending many hours at work and I was losing a lot of time, quality time with my children. Therefore I decided to study teaching because as a teacher you get a lot of holidays, there's flexible hours, main thing for me was to spend time with my children especially as a single parent. I will say I do have a passion for teaching but we are definitely underpaid." (Lita)*

From the five responses, what stood out was that none of the participants chose teaching because they wanted to become teachers. The qualities of passion, motivation, and enthusiasm were also absent from their explanations of why they chose to become teachers. Instead, they chose it for reasons related to extrinsic motivations. According to Noor et al. (2021), highly motivated teachers are essential for an effective educational approach since teachers' commitment and effectiveness play a significant role in realising any nation's educational goals. While Kayla stated that teaching suited her lifestyle, Ariel stated that teaching did not require her to travel longer distances which was the greatest attraction for her. On the other hand, Lia identified a gap in her original

choice of profession and found teaching to be a viable option. Lita expressed that the hours and holidays were most attractive as she was seeking for a job that allowed her to spend more time with her children. The reasons above could have a negative impact on the participant's experiences as teachers, as teaching is more than just having long holidays and fewer hours. A number of teachers leave the profession because they entered it with unrealistic expectations, and the reality of multiple preparations, unpaid orientation sessions, and bigger workloads exceeded their expectations (Elaine, 2013). High teacher attrition rates are not an issue limited to South Africa, but it is also an international challenge (Amitai & Houtte, 2022). Mampana (2012) found that teachers leave the profession due to burnout caused by their inability to cope with the workload. Other reasons include the lack of support and poor working conditions. Learner achievement is negatively impacted by teacher attrition, meaning a continuously changing teaching force is detrimental to learners (Ronfeldt et al., 2013). Therefore, it is imperative that teachers who enter teaching for reasons other than a desire to teach are made aware of the realities of the profession to avoid teacher attrition and dissatisfaction.

The challenge with motivation that stems from altruistic and extrinsic motives is that for these demands to be satisfied, teachers may be dependent on outside forces and may not be self-motivated (Moosa, 2020). As such this could force teachers to exit the profession. If they are unable to exit the profession they may grow despondent and pessimistic about the demands imposed on them and, as a result, are unable to perform effectively. The teaching profession requires dedicated and hardworking individuals who are willing to go the extra mile to assist weaker learners by providing extra classes, amongst other factors (Mart, 2013). However, observational data has revealed that although the five participants entered the profession due to extrinsic reasons, three out of the five participants displayed devotion to the profession and made a concerted effort to develop their learners. One of the participants called the learners who struggled to understand what was taught to the table and provided one-on-one attention and assistance. On the other hand, the other two participants displayed a lack of motivation and interest in how they taught and responded to learners. During the lesson observations, both participants made similar comments such as "These learners don't understand anything", "Teaching is an exhausting profession", "You can teach the same thing repeatedly and you will still have most of them not getting it correct". Through

these comments, a sense of frustration and unhappiness seemed to prevail, as these teachers were not thrilled with the engagements in their classrooms.

The South African Council of Educators (SACE) also states that a teacher must abide by the Code of Professional Ethics. More specifically, it outlines that a teacher "acknowledges the uniqueness, individuality, and specific needs of each learner, guiding and encouraging each to realise his or her potentialities" (SACE, 2000, p.4). Teachers are, therefore, meant to plan their lessons by considering how learners think and develop. This suggests it is possible that the participants of my study did not plan according to the needs of their learners. Eva's reason for taking teaching is not also about teaching as a profession but hers is closest as she wanted to become a child psychologist. As a teacher she got to work with children although not to the standards of her primary degree.

What is silent from the data yet worth noting are the socio-economic reasons for taking teaching. Anecdotal evidence in South Africa suggests that there is employment in the teaching profession. This has therefore drawn interest from different individuals who are taking teaching primarily because of its employability and not necessarily passion. Who decides to teach may be influenced by governmental regulations and economic factors. To encourage students to enrol in teaching programmes at South African universities, the Department of Basic Education has made the Funza Lushaka Bursary Scheme available. According to preliminary surveys, some students enrol for the bursary programme not because they are drawn to the teaching profession but rather because of South Africa's general socio-economic plight (Mampane, 2012). One of the biggest draws to teaching in Cyprus, for instance, was the promise of immediate employment after studying. Similarly, Ubuz and Sar (2008) discovered that the majority of their 109 participants made their decision to become primary school teachers for extrinsic reasons because of the profession's considerably higher employability prospects. In the next section, I present altruistic and intrinsic motivations.

According to Struyen et al. (2013), altruistic and intrinsic motivations are recommended as the primary motivators, with extrinsic motivations serving as a complementing factor. Concurring with Struyen et al. (2013) is Sinclair (2008), who argues that teacher retention increases in the case of intrinsic and altruistic motivations. As explained earlier, the act of engaging in an activity for its own inherent satisfaction rather than

seeking a separate benefit is known as intrinsic motivation and the urge to transform other humans is what drives altruism. In line with these definitions, it makes it possible to establish an understanding of teachers' decisions on choosing to teach. Likewise, Malmberg (2006) found a link between motivations and teaching methods, as well as between job happiness, interest in learners learning, and engagement. Thus, by gaining an understanding of the most dominant motivator behind their choices to become teachers, I was able to better understand what drives them as teachers. Two of the participants' reasons for becoming teachers appeared to be intrinsic motivations:

> "*Um teaching has been in the family for a long time but personally it has been one of my goals. For me becoming a teacher is one of the most successful things in life. Yeah, you get a lot of happiness from teaching.*" (*Adrian)*

> "*I became a teacher because back in the day becoming a teacher was a good thing and it was called locum teaching. At first, I was not in love with it but as time went on, I started to love the profession. I enjoy working with children and imparting knowledge to them. And I'd like to see them grow and become something spiritually, mentally and become someone in life. When I first studied, I studied public administration then I broadened it into teaching (PGCE) where I did social science.*" (*Mike*)

From Adrian's and Mike's responses, it becomes evident how their choice to become teachers shaped their views on teaching; they therefore responded differently to the question in comparison to the other five participants. Adrian and Mike related their reasons for becoming teachers to wanting to make a difference in the lives of children, imparting knowledge to learners, and becoming a teacher meant happiness for them. One of the differing qualities between the five participants and the two (Adrian and Mike) is passion. Garrison and Liston (2004, p. 1) state "Those who feel the call to teach, who sense teaching is a profoundly meaningful part of their life, have a passion for teaching". According to Vallerand et al. (2003), passion is a self-defining activity that one enjoys or appreciates and devotes a large amount of time and attention to. Likewise, Day (2004) defines passion as the love a teacher has for the subject they teach, for their learners, and for the strong conviction that they can make a major difference in their learners lives through education. From Adrian and Mike's responses, it reveals their love for the profession and the desire to make a change in learners' lives.

Zhang (2014) conducted a study looking at how teachers' passion affected learners' motivation and engagement. The findings showed that the involvement of learners in the classroom was significantly influenced by the teacher. Learners got more engaged with teachers as their enthusiasm increased. Results also indicated that students' intrinsic motivation was better predicted by the teacher's enthusiasm than by the students' extrinsic motivation. The study looks at non-specialist mathematics teachers, therefore whilst the participants did not specialize in the subject and received specialised knowledge in mathematics, passion can be used as a teaching tool to motivate non-specialist teachers to become more knowledgeable about the subject and become effective teachers. Zehm and Kottler (1993) define passionate teachers as those who genuinely enjoy what they do. For learning to be high-quality and successful, passion is key. It is a factor that improves teachers' effectiveness and motivates them to raise learner progress (Serin, 2017).

Shulman (1986) highlights the significance of teachers being fully aware of their learners and their characteristics under the seven knowledge bases that a teacher must have, and stresses the importance of teachers being able to adapt materials to suit them and to engage learners in meaningful lessons by understanding the conceptions and preconceptions that learners bring to the learning. This concept is in line with the SACE Code of Professional Ethics, as mentioned earlier, on the importance of teachers acknowledging the uniqueness of their learners. The theme has pointed out the relationship between a teacher's choice to become a teacher and how it impacts on being a passionate teacher. From the data, one can see the difference between the participants who chose to teach as a fallback career and how they experience teaching and those who chose teaching because of passion. The study noted stark differences between these teachers in terms of their teaching, attitudes to learners, and knowledge base. As Tamir (1991) argues, a person's actual behaviour in their line of work results from the interaction of their professional and personal knowledge. The next theme identifies the teacher's curricular knowledge, which is a crucial aspect of an effective teacher.

5.3 Theme two: Teacher's curricular knowledge

According to Christie (2012) and Schleppegrell and Christie (2018), curricular knowledge is one of the key elements of the teacher knowledge base. According to Shulman (1987), a teacher's knowledge base includes, among other things, their capacity to manage their classrooms, create lesson plans, and provide learners with clear explanations. Curricular knowledge has three dimensions: (a) alternative curricular knowledge, which is knowledge of

additional resources for teaching a subject; (b) lateral curricular knowledge, referring to teachers' ability to connect the content of a specific subject with other subjects studied by learners; and (c) vertical curricular knowledge, defined as the teacher's knowledge of the subjects that were and will be taught in previous and subsequent years (Shulman, 1987). This theme will focus on the participant's teaching approach, subject matter knowledge and the types of assessments they conduct.

5.3.1 Teaching approach

During the data generation, I looked out for two prominent teaching approaches: a teacher-centred approach and a learner-centred approach. According to Emaliana (2017), the teacher-centred approach views learners as passive recipients of knowledge. On the other hand, the learner-centred approach moves away from the teacher as an instructor to a facilitator. Teachers assist in guiding learners, supervising their activities and directing their learning, while they are also active participants in the learning process (Emaliana, 2017). In addition, when learners can communicate with one another and engage actively in their learning, learning activities engage their attention longer (Mpho, 2018). Therefore, several studies (Emaliana, 2017; Mpho, 2018; Serin, 2018) have outlined the importance of adopting a learner-centred approach as it provides learners with opportunities to develop their analytical and problem-solving skills and to become critical thinkers. What emerged from the interview data was that all seven participants used a learner-centred approach although they stated it was difficult. The reasons given varied from time constraints to large class sizes and resources. Below are the responses from the participants on the teaching approach they use during their lessons:

> "*I try and use the learner-centred approach. It is the approach that we are meant to be using although it is hard to always make sure your lessons are learner centred because sometimes learners misbehave and there isn't always enough time". (Kayla)*
>
> **Researcher (Me)** : "*What approach do you use when teaching"?*
>
> **Ariel**: "*Umh (long pause) ".*
>
> **Researcher**: "*For example, do you use a learner-centred or teacher-centred approach?*
>
> **Ariel**: "*Oh, I'm not sure; I think a learner-centred approach*."

Researcher: "*A teacher-centred approach is where you are the main transmitter of knowledge and a learner-centred approach is where the learners are active during lessons and contribute significantly to the lesson*".

Ariel: "*Yes, then it is a learner-centred approach*".

"Look you want it to be learner-centred but unfortunately, due to circumstances at school, it cannot be learner-centred. Taking the class sizes, and less than one hour it is very difficult. Most of the time you are doing the talking and learners are listening. But as time goes by, I am trying to improve my lessons to include learners more. But at the beginning which was in my first and second year my lessons were teacher-centred because I was not confident enough." (Adrian)

"I try and make it more learner-centred but it's difficult to cater to all the different learners." (Mike)

"I use the learner-centred method. I feel this method helps me to interact with my learners and it also helps me to ascertain their level of understanding. Makes my lessons more engaging and exciting." (Lita)

"I use the learner-centred approach. Because the learner understands better and they grasp things easily, they can participate and ask questions because they feel part of the lesson. The lesson becomes stimulating and exciting." (Lia)

Upon analysing the data, it became evident that only two out of the seven participants displayed a solid knowledge of the learner-centred approach. Throughout the lessons of the other five participants, they taught the content with little interaction from the learners. The classroom situation also depicted a teacher-centred style as learners were seated in pairs, facing the chalkboard, and not in groups. As Boostrom (1991) alludes to this point, in teacher-centred classrooms the physical environment is designed to promote this type of approach where learners' desks are placed to face the primary focal point, the teacher. The learner activities were also teacher-centred. Learners passively received the knowledge from the teachers and did as they were told. Kayla, Adrian and Mike's responses suggests that they are aware of the approach but are unable to adopt it during their lessons. Kayla was unable to use a learner-centred approach due to discipline issues and time constraints. Adrian tried but the learners were not fully participating; his learner-centred approach ended with a few moments of questioning and answering. On the other side, Mike attempted but was unable to effectively

accommodate all the learners in his lesson. In addition, during my observation of Mike's lesson, the lesson's aims and objectives were not in line with the content. The lesson aims and objectives were "learners will be able to multiply 2 by 3 digits", but the teacher taught learners multiplication of 2 by 2 digits. Mike also did the example on the board incorrectly but realised it on his own and corrected the error. Eva, on the other hand, began her lesson by gaining an understanding of learner's prior knowledge on the topic. This created an interaction between the teacher and learners, demonstrating a partial learner-centred approach. She then proceeded to write an example on the board which was deliberately done incorrectly. She wrote down a 3-digit number on the board and asked learners if she is correct. She put the first number under the thousand column second under the hundred and the third under tens. She explained to the learners that she is incorrect as 3 digits stand for hundreds, and she wrote the first digit under the thousand column therefore it was still incorrect. Although she did provide more support to learners compared to the other participants her lesson was predominantly teacher-centred.

During the lesson observation, Kayla seemed to have had a challenge with gaining control over the learners as there was constant chatting amongst the learners whilst she attempted to teach. Although she did reprimand the learners for being disruptive, it seemed to have had no effect as they continued to talk. My observations of her teaching style and interactions with the learners led me to believe that there may be a communication gap between her and the learners. She, therefore, devotes a lot of time on discipline. Strong relationships between learners, and teachers are regarded to lessen the need for control and serve as the foundation for all classroom interaction (Dollard & Christensen, 1996). Therefore, a learner-centred approach is incomplete without this relationship. Consequently, her lessons were teacher-centred as this form of relationship was absent between the teacher and learners.

Similarly, Ariel's lessons were also teacher-centred. Ariel was unaware of what approaches a teacher is meant to use. After explaining the different approaches, she stated that she uses a learner-centred approach. On the contrary, her lessons were teacher-centred with limited interaction from the learners. The only way she involved learners in the lesson was through a few questions. The rest of the lesson was managed and controlled by her., Ariel did not see the way she taught as an issue. She found this way easier to manage the learners as there was no talking. Ariel also tended to ignore the learners when they raised their hands during the lesson observation. She responded to learners by stating that she will get back to them to answer their questions, but she did not. Ariel seemed to have also lacked confidence in teaching mathematics, she was nervous and made mistakes during her teaching. Ariel indicated during

our interview that she has approximately three years of teaching experience. The first few years of a teacher's career are seen to be the most challenging for them (Gavish & Friedman, 2010). The limited number of years she has been teaching could be a contributing factor to her lack of confidence and lack of experience in teaching mathematics as a non-specialist. Ignoring the learner's questions disadvantaged her from the opportunity to engage the learners and understand them. Consequently, the weaker learners bear the brunt of this type of approach. This suggests that novice teachers require support and guidance to assist them during their beginning years of teaching.

Research shows that teachers with less in-depth subject knowledge would emphasize facts over comprehension, rely more on textbooks than hands-on activities, and engage with learners less, with the result that learners are expected to work more independently (Aubrey, 1994; Golafshani, 2013). Hence, this could be one of the main reasons the participants employ a teacher-centred approach in their classes. Brophy (2006) argues that an instructional system that prioritises active learning, higher-order thinking, and the social creation of knowledge undermines the potential effects of a management system that encourages learners to be passive and comply with strict regulations. Although most of the participants indicated that they use a learner-centred approach during the interviews, the lesson observations did not show this.

Lita and Lia are the only two participants who have demonstrated a learner-centred approach. Upon observing Lita and Lia's classrooms I noticed similarities in how they executed the learner-centred approach. Learners were actively involved in the lessons and the ethos of their classrooms was also different from the rest of the participants. The ethos of their classes was exciting and interactive. A lesson that is actively delivered to the class increases the likelihood that the learners will be internally motivated to study the material (Tran & Le, 2022). Learners enthusiastically shared ideas and worked together to solve problems presented to them whilst the teachers walked around observing and noting queries. Both lessons were a combination of a teacher-centred and learner-centred approach but predominantly learner-centred.

Whilst it is not bad to use a teacher-centred approach, it is not advisable for it to be the main teaching style used by teachers. Some of the benefits of a teacher-centred classroom are that there will be order in the class as the teacher exercises full control and may feel confident. However, the drawbacks of this type of approach are that it is solely dependent on the teacher's knowledge, and it removes opportunities for collaborative learning and the promotion of

critical thinking skills among learners (Garrett, 2008). The learner-centred approach is where the teacher allows learners to be active in the learning process, thus, allowing learners to be independent and build their collaboration and communication skills. Teachers who are more knowledgeable in their subject matter, tend to teach in a more engaging manner, deliver it in a variety of contexts, and are generally positive and more receptive to learners' queries and comments (Junqueira & Nolan, 2016). The learner-centred approach was only evident in the lessons of two participants, who have stated that they love mathematics and enjoy teaching it. However, this approach also has drawbacks. It requires a teacher who can manage classroom discipline or understand alternative ways of discipline during interactions and promote critical thinking among learners. This was one of the points brought up by some of the participants. They noted that it becomes difficult for them to manage their classes. The next theme will look at the participants subject matter knowledge.

5.3.2 Teachers' subject matter knowledge

Four dimensions of subject matter have been identified by researchers that affect teachers' pedagogical practice: subject-matter expertise, knowledge of the subject, syntactic knowledge, and subject beliefs (Wilson et. al, 1987). Teachers' subject matter refers to their knowledge about a subject. PCK is about how the teacher represents knowledge in ways that are meaningful to learners (Shulman, 1986). From the lesson observations, it became evident that many of the participants displayed a lack of subject matter in mathematics which affected their teaching. Grossman and Richert (1988) argue that a teacher who does not have a solid understanding of the subject matter will struggle to present and unpack knowledge to the learners.

Shulman (1986) argues that subject matter knowledge (SMK) alone is not enough for teachers; what is required is a specialised body of knowledge which is PCK. The teaching process is distinctive and necessitates that teachers 'transform' their subject matter knowledge for instructional purposes (Shulman, 1986). This transformation takes place as the teacher critically evaluates and interprets the subject and finds various representations of the information. These include analogies, metaphors, examples, problems, demonstrations, and/or classroom activities. The data indicates that five of the seven participants may be lacking SMK. The possible lack was evident in their teaching, lesson plans and class activities. Before gaining an understanding of the teacher's subject matter knowledge, I wanted to understand their

feelings towards teaching mathematics and whether there is a relationship between their feelings and subject matter knowledge. Below are the responses of the five participants who described how they feel about teaching mathematics as non-specialist teachers:

> "*I feel fine now, over the years I have gained experience teaching the subject but I was not always happy about teaching mathematics as I teach grade 7 maths and it can be challenging at times." (Kayla)*

> "*Sometimes it is a bit challenging because there are certain sections that we didn't do in school as well. Like for example this breaking up method we didn't do breaking up method we just calculated the vertical method. Teaching them [learners] this method it's difficult. So, you must find other ways to try and teach the learners." (Ariel)*

> "*To be honest at first it was a bit daunting. I didn't know where to start. When I came to the school, I was just given a textbook and they said I must do this and that. It is a slow process, but it is getting better. What helps is when you have senior teachers that show you around and especially what helped me was the Edu-fundi programme. So, I would say I am not 100% fully confident but in due time I should reach there." (Adrian)*

> "*It has its challenges because obviously you are thrown in the deep end and also I've been doing maths in grade four for the past five or six years And then you have challenges like language barriers and you have to find the simplest methods to teach these kids and if you look at it we do not get help from the department. Nobody assists you, nobody comes to see you, nobody gives you lessons and teaches you, for example, how to teach fractions. You basically teach from your own experience; you have to find your own methods to teach. I've taken it upon myself to go and do research and find methods to help my learners." (Eva)*

> "*One thing I have learned as a non-specialist teacher in the beginning you will experience great difficulties and challenges. Although you may be confident to teach, you will find that you don't have the necessary knowledge and expertise to teach certain topics and only when you're faced with the curriculum and textbook showing you sums to do, then you realize it's difficult. But over the years I grew as an educator, I have developed as a maths educator. Only now I can*

just go and stand in the front and just teach but couple of good years back I was unable to do that. So, with everything, practice makes perfect. If a novice teacher had to be given a grade seven class to teach maths as a non-specialist it can go both ways. It can be that they may have a good background knowledge of maths or it can go terribly bad where they can be teaching learners incorrect stuff and which will also make the teacher gain insecurities. And for me grade seven is a very important grade; it is an exit grade as they will be entering high school afterwards so I feel that grade sevens should be given extra importance in terms of the educators that they are given. They need a firm grounding on maths. The proper foundation must be laid down in this grade. Ideally novice teachers should be given lower grades before being sent to teach higher grades as it would be an injustice to learners." (Mike)

The data above suggests that the participants are aware of their challenges and weaknesses in their position of being non-specialist mathematics teachers. From their responses, they relate their challenges to having a lack of subject matter, training, and support. However, Adrian indicated that the Edu-fundi programme assisted him greatly. This programme is run by a non-profit organisation that focuses on education and offers teachers and leaders in primary schools help through in-class mentoring. This suggests providing mentorship to teachers assists their teaching practice significantly. During their early years of teaching, five participants (i.e., Kayla, Ariel, Adrian, Eva and Mike) were apprehensive about teaching mathematics owing to their lack of subject matter knowledge. Most of the participants stated that, had I conducted this interview when they first started teaching, they would have wanted to change from teaching mathematics. The reasons were a result of a lack of confidence and limited experience teaching mathematics as non-specialists. The participants also indicated that the interviews were beneficial for them as they were able to express their feelings and challenges relating to their teaching. It also assisted the participants to feel more at ease, knowing that I am also a non-specialist mathematics teacher in a primary school. According to Hodgen and Askew (2007), teachers usually transmit their fear or apprehension about mathematics to their learners through instruction. Their apprehension and lack of knowledge were evident during the lesson observations. Kayla began her lesson by stating the topic and providing a brief explanation of the term exponents. She did not expand on the topic. One example was done on the board, and she asked a learner to provide the answer and the learner got it incorrect. Kayla did not explain

to the learner why she got it wrong, instead, she went ahead and wrote down the correct answer on the board, ignoring the learner's misconception of the topic.

Kayla seems to have limited knowledge of certain concepts in mathematics as she avoided answering or delving further into the topic. Learners were also not provided with support during the lessons. Instead, Kayla got upset when a learner had to ask for help and responded negatively. Hotaman (2010) argues that a teacher is fundamental in creating a positive attitude amongst learners through their own actions. Furthermore, encouragement and support help the learners to accomplish more academically and have fewer behavioural and disciplinary issues (Henson & Eller, 1999). Kayla displayed a lack of interest and knowledge in understanding the needs of her learners.

Similarly, Adrian began the lesson by delving straight into the lesson. He wrote down the topic on the board and did an example to show the learners. The example he did was incorrect. He made an error when placing the numbers using the column method. The ten thousand number was placed under the thousand column. This error was also evident in his lesson plan. The teacher did not realise until a learner pointed it out. This is an indication that he may lack subject matter and PCK as he was unable to teach the learners the concept correctly. He also did not use multiple teaching methods.

Contrary to the data and discussion above about the five participants, below are the responses from Lita and Lia, who have stated that they love teaching mathematics despite being non-specialists:

> "*I love it because I loved working with numbers, analysing things, critical thinking; stemming from my childhood I enjoyed maths." (Lita)*

> "*I enjoy teaching maths only because I am good at maths in general. Maths is a complex subject and my love for maths helps me teach it effectively." (Lia)*

The difference between the five participants and these two was apparent. The data obtained from these participants highlights that there is a link between teachers' feelings and how they enact the curriculum, which relates to their subject matter knowledge. The five participants perceived mathematics as a challenge and were not confident in teaching it and therefore struggled to teach effectively, whereas the other two participants explained that they love mathematics and taught the subject effectively. As noted earlier in this chapter, other participants employed a teacher-centred approach in their lessons, Lita and Lia used a learner-

centred approach. What stood out from Lita and Lia's lessons was the use of visual aids. Visual aids, according to Fish et al. (2016), are tools used in classrooms to motivate the learners. They are sensory things or images that initiate, excite, and promote the learning process and make it simpler and more engaging. Resources for teaching and learning promote and aid learning, aiding learners in comprehending and appreciating the lesson (Adjei et al., 2015). Lita began the lesson by recapping from the previous lesson. She wrote the word divide and the sign on the board. She then called out two learners and handed them a page and asked them to tear the page in such a way that she and the learner get the same size. Lita congratulated the learners for tearing the page in half. She began the lesson in that way to visually explain that divide means to share equally. She then wrote a definition of division on the board and asked learners to take it down. Thereafter, she called out two different learners and asked them to tear the page in such a way that four people get the same size. Learners were actively participating during most of the lesson. Lita then wrote down a division sum on the board and explained it to learners by using concrete examples such as the paper. Lita displayed a solid understanding of mathematics and was able to assist learners when they were stuck.

Lia began her lesson by doing a recap of the previous lesson. Good pedagogical practice mandates that we should spend a few minutes each lesson reviewing and retrieving what we covered in the previous class in order to get everyone up to speed, prepared to move forward, and to strengthen the neural connections (Stavnezer & Lom, 2019). Lia asked random learners to explain what they learned a day before. She then explained the topic of subtraction and stated that subtraction is commonly known as minus. Sidik et al. (2021) have pointed out the importance of breaking down the process of subtraction for learners. This is to eliminate common misunderstandings found when learners subtract and must borrow from different place values. Lia drew the four operation signs on the board and asked learners to raise their hands for who wanted to come and show which sign is a subtraction from the four. She used some chalk to demonstrate a simple subtraction sum to learners. Lia displayed a solid understanding of mathematics and was able to assist learners when they were confused. Especially when there were sums that required taking away, she was able to effectively guide learners in resolving the common misconceptions. Lia also displayed a broad understanding of mathematical concepts as she put all the terms that are commonly used for subtraction on the board, for example, difference and take away. The data above suggests that non-specialist teachers who lack SMK and PCK will struggle to implement the curriculum. By making comparisons from the study, the data shows that the two participants who displayed a strong

SMK implemented the curriculum effectively and their lessons were more engaging and spoke to the needs of the learners. In contrast, the five participants who lacked SMK, were faced with several challenges and were unable to efficiently engage learners during their lessons. The next theme will look at the assessments that the participants used.

5.3.3 Assessment

Assessment is crucial to the teaching process and plays a significant part in education. Teachers can categorise and evaluate their learners through suitable assessments, provide feedback, and structure their lessons accordingly (Tosuncuoglu, 2018). To ensure that children learn in a meaningful and effective way, lessons must be carefully organised to take into account the characteristics of the learners, such as their prior knowledge and aptitude. Assessments are also used to pinpoint the problems and strengths of certain learners so that teachers can offer individualised academic support, educational programmes, or social services (Yambi, 2018). One of the knowledge bases that Shulman (1987, p. 7) highlights as important to have is "knowledge of learners and their characteristics". Shulman (1986) pointed out that this aspect of a teacher's knowledge base depicts the route a teacher will take when planning their teaching and assessments. In understanding how teachers plan their assessments I will focus on Shulman's transformation process. Before teachers transform their understanding into content for the learners to easily understand, they are likely to engage in the following four processes: preparation, selection, presentation, adapting and tailoring to learner's characteristics. A crucial aspect of preparing effective assessments is through reflection. Teachers need to be reflective to gain an understanding of where their learners are struggling and decide on improvement as well as assessment. As Shulman (1987) states, before teachers transform their understanding of the information, they are going to teach into a form that the learners can understand, they need to engage in critical reflection and interpretive work on the subject. The participants were asked to elaborate on how they assess learners understanding of the content taught and responded as follows:

> "*I call my learners to the board to show me what they understand. If not, I write the name on a page and I collect it, just a small piece of paper, just one example they must do it by themselves and then I will collect it. And then after in my own time I will check. I will see where they went wrong, and I will call them maybe individually to assist." (Ariel)*

Ariel's first method of assessment does not allow her to gather a true reflection of the learner's understanding, as she has 36 learners in her class. Therefore calling 36 learners to the board is time-consuming and may result in further discipline issues. Furthermore, during the lesson observations, the aims and objectives of the lesson were not in line with the type of assessment the teacher gave the learners. The lesson was on expanded notation and learners were given an activity that had the numbers already written in expanded form and were required to write them in words. Teachers must be able to develop and use appropriate assessments to gauge student learning and assess the efficacy of their instruction (Mellati & Khademi,2018). This form of activity will not show the teacher whether the lesson was a success as it did not test what was taught. On this note, Shulman (1987) contends that the primary goal of assessment is to determine the learners' level of understanding and comprehension of the content taught. In Ariel's case the assessment will not yield this result.

> *"The assessment is informal. After an activity is given, I write the answers on the board and the learners mark their answers with a pencil in their books and at the end of the week I assess books and then after that, it is formal testing. If more than half the class did not understand the topic, I will re-teach it." (Adrian)*

Adrian, states that he only assesses learners' books at the end of the week. This kind of approach may create a challenge in gaining an overview of his learner's understanding of the topic as marking only takes place at the end of every week. Adrian appears to be using self-assessment where learners would mark their own work based on answers provided by the teacher. Self-assessment, according to Brown and Harris (2013), is the process by which a learner describes and evaluates his or her own work and academic achievements. Tosuncuoglu (2018) argues that maximising retention during the learning process can be accomplished by giving the learner continuous feedback (formative assessment) through the teacher's assessment of their work. Formal assessments are done for purposes of progression and certification; the teacher formally marks and records the results of assessment tasks. A formal assessment gives teachers a methodical technique to measure how well learners are developing in a grade and in a specific subject (DBE, 2011). Thus, the planning of his lessons will not accommodate the learner's misconceptions as continuous and regular feedback was not provided to the learners. Below is Lita's response on how she assesses her learners:

> "*So I use a method called the exit routine, whereby learners are given pieces of paper at the end of a lesson and they are to do one example and write their names*

on it and I collect it. I then sort it out into those who understand, don't understand and have some understanding. This helps me to know how many of them learned and how many of them don't understand. Also, I make use of informal tests which assesses learners understanding of the topic." (Lita)

Lita has a structured way of assessing her learners, which is seeking to determine the levels of understanding among her learners. Through this method, she is able to measure clearly where learner's misconceptions lie, as she has divided the learners' responses into categories. This method of assessment can be referred to as continuous assessment. This form of assessment regularly assesses learners progress to determine their level of understanding (Obi & Obineli, 2019). The results from this assessment can be used to plan her future lessons with the learners in mind. This will assist in helping learners to gain more clarity, and attention can be provided to the learners who have fallen into the 'don't understand' category. During her lesson on subtraction, she grouped learners and got a group leader from each group to hand over the answer sheet whilst she marked it immediately. The learners were ecstatic when they performed well and received a sticker. This stresses the importance of regular feedback and the impact it has on learner motivation.

The themes in the chapter have provided an overview of teachers' curricular knowledge and the various factors that make up this knowledge. Botha (2012) explains that teaching mathematics is a specialised profession that calls for content knowledge, curricular knowledge, knowledge of how to teach mathematics, and knowledge of how learners acquire mathematics. Hence, the data revealed that most of the participants lacked these aspects and therefore struggled to teach mathematics effectively. The data also revealed that teachers who lack SMK tend to use a teacher-centred approach to avoid confrontations with the learners and manage their classrooms. The intermediate phase CAPS document for mathematics calls for a balance between learner- and teacher-centred methods (DBE, 2011). In addition, a lack of SMK has shown to also impact on the preparation of appropriate assessments. Metler (2003) argues that, due to insufficient pre-service and in-service training, the majority of teachers are ill-equipped to evaluate learner's progress. Which highlights a greater need for the skilling of the teachers. The next theme will provide data regarding the challenges faced by the non-specialist mathematics teachers in teaching mathematics.

5.4 Theme three: Challenges in teaching mathematics

The study has noted that the participants have experienced several challenges whilst trying to implement the curriculum as non-specialists. These challenges have impacted their practice as teachers. The most crucial factor in learners' success is their teacher (Hattie, 2009). Possibly due to their own issues, the teachers were unable to have an impact on learners' achievement. Considering this, it might be crucial to highlight the issues that teachers face. The subsequent paragraphs will highlight the challenges faced by the non-specialist teachers.

5.4.1 *Training and support*

A common challenge faced by most of the participants was a lack of training and support. In Mbatha's (2016) study, this was also found to be a challenge, with the participants in the study often highlighting a lack of training, support, and resources as factors that are inhibiting their growth as effective teachers. Providing teachers with training in curriculum subjects typically entails planning sessions that last a while. Keeping teachers current in their subject matter is the primary goal of these sessions (OECD, 1998). According to Cambridge Professional Development Qualifications (2014), the most important determinant in the quality of student's learning is the quality of teaching and school leadership. This statement acknowledges the value of teacher preparation and professional development. Throughout their careers, teachers must continue to advance their professional knowledge and skills. A shocking discovery from the participants' responses regarding training and support was that none of them have been visited by a departmental officials. However, it must be noted that data was generated during the coronavirus pandemic, which limited the movement of people and could be one of the reasons that departmental officials were not conducting school visits. On the same note, though, some of the senior teachers with ten years of service and more did indicate that they were never visited by departmental officials. When I asked the participants how they plan their lessons and if they receive support from either their school management team or the Department of Education they responded as follows:

> "*So I plan my lessons using the annual teaching plans (ATP) which is given to us from the Department of Education. In terms of support there isn't any from curriculum advisors I have not been received support from them. From the time I've been at the school I don't think we've ever received a visit from any curriculum advisors." (Kayla)*

> "*There is no support; my go-to is my textbook and also ATPs." (Ariel)*

Both participants' responses reveal the issue of a lack of support. The tone of most of the participants when answering this question was one of frustration and a cry for help. Teachers who receive the right training are better equipped to handle their stress, become more effective, and have higher levels of job satisfaction, which can reduce the strain caused by their jobs (Dussault et al., 1999; Bar-on, 2000; Clérico et al., 2019). The participants outlined how they struggle to cope with teaching certain topics, and they find themselves without support including from their Heads of Department (HODs). Since the teacher is the primary decision-maker in the classroom, inadequate or no training will exacerbate teachers' challenges of having inadequate subject knowledge and pedagogical skills to teach a particular subject (Boudersa, 2016). However, whilst a lack of support was a prominent issue amongst these participants, they did show an understanding of how to plan their lessons. They referred to the CAPS document and ATPs, which is a guideline to be used by teachers when planning their lessons. On the contrary, the lesson observations did not display the knowledge that the teachers revealed during the interviews. There seems to be a disconnect between their knowledge and practice. Often curriculum scholars have argued that the planned curriculum is not the enacted (Fullan, 2007). This indicates that the participants are still trying to find their feet in handling their lessons when the planned does not fully translate to the enacted.

Below are the responses from Adrian and Mike, who were the only two participants who received some form of support from their HODs. Notwithstanding the fact that they have also not been visited by a curriculum advisor.

> "*OK firstly I do receive support from my managers and HOD. My lesson planning templates are given to us, and curriculum material is given to us from our HOD. In that aspect, I do receive support. But in terms of the actual content like how to teach it or even some examples of methods it is all self-study. I look up stuff on the internet to teach myself. In my three years, I have not seen a curriculum advisor or a subject advisor. But they have come to my school to other teachers, but I have not experienced one yet." (Adrian)*

> "*I use the CAPS document and I use the Department's template for my lesson plans. At the moment we are using the amended ATPS, but yes, I use the CAPS document to plan my lessons. So, in my school we do get our managers checking on us now and then, but it is limited as they can only assist us as far as they*

know. While curriculum advisors who will have resources and more knowledge on the subject do not come." (Mike)

Although these participants received some form of support from their HODs, it did not seem to be adequate as the participants still struggled to plan their lessons to suit the needs of their learners. What is needed are specialised forms of support and training to guide and support these teachers. Due to a lack of support, the participants are unable to transform their subject matter knowledge for the purpose of teaching. As was mentioned earlier, Shulman (1986) found the skill of transformation to be significant in teaching as it involves adapting lessons to suit the needs of the learners. "Teachers cannot teach what they do not know" (Spaull, 2013, p. 5). This brings up the question of what happens to the topics found in mathematics that the participants find difficult and are unable to teach, especially with a lack of support. The observation showed that, in cases like these, teachers lacked confidence and ended up teaching the content incorrectly and committed errors. Supervision and monitoring were not done regularly to identify and address the errors. The learners bear the brunt of the teacher's inefficiencies. The study found that the only two participants who were able to manage without receiving support were the teachers who loved mathematics and had good SMK.

Furthermore, when I asked the participants whether they feel that they have been given adequate training to implement the mathematics curriculum as a non-specialist below are some responses:

"*No, not really, even though I've been teaching for so many years, there hasn't been support. There's a lack of workshops; even when you do have those few workshops, the curriculum advisors themselves are unable to answer some of your questions." (Lia)*

"*No, we definitely need more development, more support, more guidance especially for non-specialist teachers. Especially with these new amendments, new circulars with COVID around, some teachers will find it difficult to implement the maths curriculum. I feel that subject advisors should be coming every term at least to provide guidance and to check whether we are on the right track. Sometimes we feel like we want to do better we want to improve our lessons, but we have nowhere to go or no one to ask for help; we are just basically sticking to whatever we normally do. For example, after gaining*

confidence teaching maths, I try and improve my lessons and to make it more exciting for learners, but it is difficult." (Mike)

Mike's response stood out for me as he seemed to have been disappointed and expected more from the teaching profession. He stated it is concerning that no one comes and checks whether teachers are coping, especially non-specialist teachers. A study on the effects of teacher training and teaching methods on academic achievement conducted by Hafeez (2021) found that the teachers who were provided with training displayed great improvement in their teaching and student achievements increased. Ulla (2018) concurs by arguing that a teacher who received training can use more methods and abilities to help learners achieve greater academic success. The data has shown that most of the participants employed a teacher-centred approach, mainly because of a lack of SMK and the inability to manage teaching and learning. Noting the data of the study, it is evident that the participants require training to assist them in teaching mathematics, as most stated that they need support when they are faced with concepts that are hard to teach.

This reason of a lack of training and support could be the reason why the participants' lessons were predominantly teacher-centred, as they lack the support and knowledge to implement a learner-centred approach. The National Curriculum Statement for grades R-12 highlights that the aim of the curriculum is to produce learners who will be able to "collect, analyse, organise and critically evaluate information" (DBE, 2011, p.5). In this case, this will not be achieved as learners are not engaged in problem-solving, discussions, and interactive lessons that allow them to become critical thinkers.

5.4.2 Resources

Teachers are exposed to diverse learners in the classrooms. All teachers in South Africa must be able to accommodate diversity in their various classes to comply with the inclusive education (IE) policy. Studying learning preferences can reveal information about how learners pick up knowledge and solve problems (İlçin et al., 2018). These learning preferences include the use of different resources. Some learners may prefer to learn through visual resources, and some may prefer sensory resources. Phasha et al. (2013) acknowledge that a lot of teachers currently in the workforce haven't had the advantage of receiving training to teach learners with a variety of requirements, which makes it challenging to cater to the needs of every child in the classroom. As in the case of the participants in this study, a lack of training has resulted

in their being unaware of how to structure their lessons using resources to accommodate their learners. Whilst it is known that not all learners learn the same way, it is found that some teachers, specifically referring to the participants in my study, teach in the same way for every lesson, which does not accommodate all the learners. The participants responded as follows on the use of resources in their lessons:

> "*So sometimes the ATP expects you to teach a certain topic in a certain way with certain resources, but as a non-specialist teacher it is hard to always follow what is stated there. Ideally in mathematics, you want the best resources, you want smartboards, you want children to have their hands on experience with concrete examples and sometimes a worksheet doesn't do it looking at numbers on a piece of paper is boring something more stimulating would be better. Even textbooks are becoming outdated." (Adrian)*

> "*So there are many challenges and I think most schools have the same issues and one of them is the issue of resources and there are also some contextual factors such as learners backgrounds and class sizes etc. The ATP and the CAPS document expect you to teach certain topics and some of them require resources to effectively teach them, and most schools don't have resources, and I think that is where it becomes a challenge to effectively teach the topic to learners and, as you know, learners learn differently and some of them will require these concrete objects." (Lia)*

The responses from Adrian and Lia link back to Shulman's (1986) transformation process, in which teachers are meant to find various ways of representing and demonstrating content to accommodate and adapt the material for the different learner's developmental levels and abilities. In line with Shulman, Awla (2014) states that it will be hard to alter each learner's preferred learning method in the classroom because learners learn in a variety of ways. Instead, the teacher can alter their methods to better match the learning preferences of their learners. Learning styles can be categorised into three main types: cognitive, personality (psychology) and sensory (Awla, 2014). Teachers must be knowledgeable about these differing learning styles of their learners for them to be accommodated during the lesson. Drawing from observational data, most of the participants' lessons were textbook driven with most making use of the chalkboard. The classrooms did not have charts or concrete examples for learners to work with. I found that some of the teachers lacked knowledge on how to make their lessons

creative and on the impact creativity has on improving learner understanding and overall interest in a subject. The participants also refer to the CAPS document as being unrealistic in terms of the topics covered in the document. Certain topics such as measurement in mathematics may require resources like measuring instruments. For example, rulers, metre sticks and trundle wheels. This made it difficult for the teachers to teach, as the school did not have those resources.

Resources assist the teacher in making lessons more interesting and captivating for the learners. The traditional way of teaching incorporated only a lecture style and textbook-driven approach. However, learners nowadays require a more stimulating environment to retain their attention during lessons. The participants have expressed their feelings regarding the lack of resources and the negative impact it has on their lessons. Most participants in Adjei et al. (2015) study claimed that they used resources to increase learner engagement in class, as well as to facilitate understanding and motivate them. This reaffirms the value of teaching and learning resources. Another challenge faced by a few of the participants was the issue of language barriers. The next theme will provide the data around this challenge.

5.4.3 Language barriers

Language is a major impediment to learning for many learners both then (during apartheid) and currently (Mda, 1997; Lafon, 2009; Owen-Smith, 2010; & Tshotsho, 2013). Apart from a few schools, English is currently the official Language of Learning and Teaching (LoLT) in South Africa from grade four (Lafon, 2009). In addition, language barriers create further challenges for teachers who are faced with learners whose mother tongue is not the language they are teaching. The participants expressed their challenge in this regard:

> "*Language is a problem. They are unable to read like for example grade six learners if I have to call a child, OK there is a handful that can read but if I have to call these ones in the front they don't know how to read. They can't differentiate between the words 'the', 'these', etc. They don't know these simple breakthrough words. So, if they cannot read the question, so they won't be able to understand the work. So that's the challenge I've been having. If they can read they can understand what the sum is telling them. So they're unable to work independently." (Ariel)*

"*Some of the challenges I have are language barriers, lack of concentration from the children, they don't know the importance of maths." (Lia)*

The importance of language in the classroom has long been acknowledged. It is essential for both the teachers' and the learners' survival. Language is fundamental in the classroom contexts (Bailey et al., 2008). All the schools that I visited were English medium schools, with 95% of the population of learners being made up of the African race group. During the observations I noticed the learners struggled to understand as the teacher taught. Apart from the way the teacher taught, the language impacted negatively on their ability to learn effectively. Upon looking at some of the learners' books, I noticed most were unable to spell simple breakthrough words like minus or add. This is an indication of a language barrier. The contact between a teacher and learner is what makes teaching and learning possible, and for this interaction to take place, both interlocutors must speak the same language of instruction (Costa, 2021). The following theme provides discusses the data regarding the future plans of the teachers.

5.5 Theme four: Teachers' future plans

After gaining an insight into the participant's experiences, it was of great value to explore their opinions on what they would like to happen in future, especially after finding out the various challenges they faced as non-specialist mathematics teachers. Although most of the participants were adamant about teaching mathematics, I found that some of them believe there should be a reconfiguration of subject allocation.

5.5.1 Alignment of non-specialist teachers with specialist teachers

Most of the participants have expressed their concerns about teaching mathematics as non-specialist teachers. They have attributed their reasons to a lack of SMK, training, and support. A similar study by Dibane (2018) found non-specialist teachers can affect how well mathematics is taught and learned. The results of his study showed that non-specialist mathematics teachers lacked subject matter expertise and only employed one method of instruction i.e., the teacher-centred approach. Similarly in this study, it was also the case amongst most of the participants. The participants have acknowledged that they do not have specialised knowledge to teach mathematics effectively and therefore argue for core subjects like mathematics to be taught by specialist teachers. Below are the responses of the participants:

"I would suggest that subjects like maths and English should only be given to teachers who are comfortable with and feel like they have enough knowledge to teach them. In essence every subject should be taught by a specialist teacher to maximise lesson delivery." (Kayla)

"I don't agree with how teachers are placed. Especially for students coming straight out of university they have spent the four years studying their specific specialisation and then to be sent to a school to teach a totally different subject will obviously become a challenge for them. There should be a system in place. Newly placed teachers suffer the most as they are just thrown in the deep end and expected to perform as how a senior teacher would. Even if subject advisors do not come every month, but if they can communicate through WhatsApp or telephonic conversations or zoom calls just to see where they can assist and provide support will go a long way. At the end of the day, it is only going to benefit the learners." (Adrian)

"I feel that teachers should be given a choice. It is not correct to be giving a teacher to teach mathematics and the teacher has limited knowledge on it or does not feel comfortable teaching it as at the end of the day the learners will suffer because of this. Especially in primary schools, it is important that a strong foundation is laid for these learners to excel in high school and beyond. But ultimately these subjects should be given to specialist teachers." (Lia)

"So if you are placing non-specialist teachers, it is recommended that you at least provide support for them or team them up with an experienced teacher, for guidance. I am only fine teaching maths because I'm teaching it to a lower grade. I was actually offered a post to teach maths in another school for grade seven and I declined the post because I was too afraid, and I was not confident and I had to tell them I'm very sorry and declined it. So, I would also think that it's dependent on the children that you're teaching. The smaller ones are less intimidating so you will be more comfortable teaching them as compared to the older ones." (Eva)

The responses from the participants illustrate their views towards teaching mathematics and have stated that placing non-specialist teachers to teach core subjects is a disadvantage to the learners. Eva's response indicates that she lacks SMK and PCK and stated that she would be

uncomfortable teaching higher grades. Mathematics teachers, according to Reys and Fennell (2003) and Botha (2012), are expected to have knowledge above the grade level they teach. This implies that Eva lacks this knowledge. Eva also mentioned during the interview that she feels she will benefit remarkably through mentorship from senior teachers. The Texas Teacher Mentoring Advisory Committee (2015) in the United States established guidelines for mentor teachers in a programme for novice teachers. This programme offers an extensive induction that combines official examinations, professional development, and support, and mentoring for new teachers in their initial teaching years. Such initiatives have shown to be successful in retaining strong teachers, identifying underachievers, delivering clinical training, and cultivating a supportive community of teachers (National Partnership for Teaching At-Risk Schools, 2005). Moreover, Swars et al. (2018) state that learners can build critical mathematical thinking and problem-solving skills with the help of mathematics specialists, but this was not the case with non-specialist mathematics teachers.

The participants called for an alliance of specialist teachers with non-specialist teachers to learn the basics and become proficient in the subject. They mentioned that they need support and believe it will help their practice significantly. Specialist teachers are believed to have specialised knowledge and are aware of a range of teaching styles that non-specialist teachers believe can be taught to them.

5.6 Conclusion

The data has revealed that there is a relationship between teachers' motivation and their attitude to teaching. It is believed that to become a teacher it is imperative that you have a passion. This study has shown that non-specialist mathematics teachers have been placed to teach mathematics without being given an option to teach what they specialised in. The majority of the participants stated that core subjects like mathematics should be allocated to specialist teachers who possess the required specialised knowledge to teach the subject effectively. Furthermore, the chapter also revealed challenges relating to a lack of support, training, and resources to assist non-specialist teachers with their teaching. The data has also indicated that majority of the participants were more comfortable with a teacher-centred approach than with a learner-centred approach. The next chapter will present a discussion of the key findings, implications and the overall conclusion of the study.

CHAPTER SIX- DISCUSSION, IMPLICATIONS AND CONCLUSION

6.1 Introduction

The previous chapter presented an analysis of the findings. The findings were categorised into four themes which assisted to respond to the two research questions of the study. The two research questions as stated in the previous chapter are: (1) What are the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools? and (2) How do non-specialist mathematics teachers implement the curriculum in the intermediate phase at Tongaat schools? Thus, the focus of this study was on exploring the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools. The intention was to explore how non-specialist teachers' experiences shape their teaching of mathematics. The purpose of this chapter is to demonstrate how the study attempted to address the research questions by providing a summary of the key findings. This chapter will provide a discussion of the findings, implications for policy, practice and future research, and a conclusion to sum up the rest of the study.

6.2 Discussion of findings

The key findings from the study are presented and discussed in this chapter, I present the findings in a manner that demonstrates how the findings respond to the research questions.

Research question 1: What are the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools?

Experience is typically understood to be the collection of events that take place in a person's life (Quinones et al., 2001). In line with this, the study attempted to understand the lived experiences of non-specialist mathematics teachers in relation to how they implement the curriculum. It is considered that prior experience bestows useful knowledge and skills that may be applied to the current work situation (Schmidt et al., 1986). I found that most of the participants did not have a plain sailing experience of teaching as non-specialist mathematics teachers. The reasons varied from participant to participant. I thought it was necessary to record the participants' motivations for choosing to become teachers at the outset because they represent one of the most crucial indicators of a teacher's ability (Löfström et al., 2010). According to Struyven et al. (2013), there should be a balance between extrinsic and intrinsic

motivations, which serve as a complement to altruistic and intrinsic motivations. The findings of this study revealed that most of the participants became teachers due to extrinsic reasons. Yet the evidence is that extrinsic motivators have a considerable negative impact on learning, despite the simplicity and allure they initially provide (Kohn, 1999). When people are motivated through incentives and rewards, there is less of a chance that they will develop and maintain true interest and self-generated motivation (Legault, 2016). Similarly, the motivation behind choosing to teach impacted on the participant's passion and enthusiasm for the profession. Some of the participants did not seem to be happy with teaching, and this was visible during the lesson observations. Two of the participants had similar opinions about their learners' performance; they stated they have trouble understanding most of the things that they teach the learners. The tone of the teachers indicated their frustration towards the profession and consequently, it impacted on their teaching and affected the learners negatively.

Teachers' experiences can be understood through conversations with them and by observing their attitudes to the profession (Duatepe & Oylum, 2004). A positive attitude can suggest a more productive teaching and learning environment. On the other hand, a negative attitude could stem from an unproductive teaching and learning environment. Several scholars have studied the relationship between teachers' attitudes towards teaching and the effect on their performance (Duatepe & Oylum, 2004; Harrison et al., 2006; Erawan, 2010; Nadeem et al., 2011). Duatepe and Oylum (2004) and Nadeem et al. (2011) found that teachers' attitudes towards their jobs influence their performance. In addition, Harrison et al. (2006) argue that teachers who are satisfied with their jobs are more likely to be engaged in their work, which in turn causes higher levels of performance. On this note, observing how the participants teach, respond to learners' misconceptions, manage conflict, and their work ethics enabled me to understand them as non-specialist mathematics teachers. It was evident that most of the participants were not satisfied with their jobs. Five out of the seven participants indicated that, had I conducted the study during their former years of teaching, their responses would have been different. These five participants indicated that they would have changed from teaching mathematics to another subject as they do not enjoy mathematics. The information provides insights into how these participants perceive mathematics.

In addition, the findings from the lesson observations were that some of the teachers lacked confidence in teaching mathematics. It also appeared that they did not possess a solid understanding of the content being taught. One of the participants mentioned that although he has been teaching mathematics for many years, he still struggles with certain concepts, and he

blames it on the fact that he does not have the specialised knowledge to teach all the topics effectively. There were only two participants who stated that they love mathematics and therefore enjoy teaching it. I was able to observe all the participants' lessons and there were stark differences in the way the teachers who did not like mathematics taught and those who did. Gul et al. (2020) state that it is important to understand teachers' attitudes, as they indicate their motivation towards their work. Hence, there are several factors that are causing the participants to lack motivation towards mathematics. A dislike for mathematics coupled with a lack of support and training, and limited knowledge of mathematics are a few of the reasons owing to the lack of motivation evident in the participants. Furthermore, the findings revealed that, apart from other factors, employability in the profession was a great attraction to the participants. The majority of the participants indicated that teaching was not their first choice but they nonetheless pursued the profession. The teaching profession also offered bursaries which also attracted them towards entering.

A study conducted by Gul et al. (2020) exploring the motivational factors to stay in the field of teaching revealed that extrinsic reasons push people to choose teaching as a profession, whereas intrinsic elements keep people in the profession over the long term. Altruistic motivational factors were found to be ineffective. In line with the findings, teachers who are motivated solely by extrinsic reasons are more likely to resign if given the chance to choose a position with better pay, less responsibility, or a higher profile. In relation to my study, this could imply the same for the participants as they have been extrinsically motivated to enter the profession except for two participants whose reasons were intrinsic. The two participants displayed a happier appearance and a more confident outlook towards teaching mathematics.

The teacher is the central figure in education (Alsubaie, 2016). Since effective teachers are seen as the foundation of quality education and learning is seen as a continuous process, there is a great demand for initiatives to advance teachers' subject-matter knowledge and teaching abilities (Boudsera, 2016). Considering this, it is vitally necessary for teachers to obtain proper academic and professional training so they can devote their time and energy to become effective teachers. A crucial finding that emerged from the study was the lack of training and support provided to the participants. The participants have expressed their feelings regarding teaching mathematics as non-specialists and have stated that the lack of training and support has made it even more complicated for them. In any field of work, continuous support and training are vital to ensure employees are developed and can keep up with new trends or

demands. In education, training and continuous support are crucial since knowledge is not something that is static; it is a dynamic process.

Participants have also indicated that, apart from the lack of support from their school management teams (SMT's), some have never been visited by curriculum advisors. Furthermore, all the participants stated that they have not been trained to teach mathematics as non-specialist teachers, which added to their challenge of teaching mathematics. Bawani and Mphahlele (2021) argue that for children to learn and be taught effectively, in-service teacher training is essential. Teacher training provide teachers with opportunities to develop themselves professionally and to learn new skills (Hafeez, 2021). Likewise, Darling-Hammond (2017) states that teacher training is essential for producing highly successful and influential teachers. However, the participants from my study indicated that this was absent from their teaching practice; instead, they were left to seek their own ways of understanding the content provided to them. Training and support are of utmost importance, especially in the cases of non-specialist teachers who are allocated to subjects that they are not comfortable with. The participants' responses revealed their frustrations towards teaching mathematics as they felt lonely and without guidance. The findings revealed that it is only two participants who received support from their colleagues. On the same note, whilst support and training are valuable, they must also be relevant to the needs of those involved. If there is training that disregards the actual requirements of the individuals and the situation, Mohammad (2004) cautions against expecting significant changes in teachers. There should be a consensus taken from teachers prior to workshops or training to identify the areas where support and training are needed. The training and support provided to them in this way will be applicable to their practice and most likely create a difference.

In a study conducted by Popova et al. (2021), the authors found that whilst there are several programmes in place to train and develop teachers around the world, few are being evaluated and the results of those that have been evaluated are varied. There are certain programmes that are successful. For example, in Liberia and Uganda, training teachers to assess student performance more frequently and to modify instruction based on the results had a significant influence on the learners' reading abilities (Kerwin & Thornton, 2021). Others show the opposite effects; a government-implemented professional development programme in China had no effect on teacher knowledge, teaching practices, or student learning outcomes (Loyalka et al., 2019), and a programme in Costa Rica that trained teachers to engage their middle school

math students more actively in learning caused students to perform worse (Berlinski & Busso, 2017).

South Africa also has programmes in place to train and develop teachers such as Continuous Professional Development (CPD). This type of programme requires teachers to accumulate a total of 150 professional development points over a three-year period, however, this programme is ineffective in achieving its desired goal. Mokhele and Jita (2010) assert that a significant number of teachers are discontented with the professional development opportunities they receive in schools and argue that the most successful development programmes they have participated in were their own initiatives. Some teachers have furthered their studies in education, which broadened their knowledge in the field and some organised meetings with seasoned teachers to learn and develop through their guidance and support. Guskey (1986) points out further that a possible reason on why the current training programmes do not work could be due to the programmes providing support in areas that are not needed by the teachers.

The discussion above shows that the participants experienced several challenges as non-specialist teachers, which includes lack of training, motivation and PCK. In the next section, I discuss the second research question of this study.

Research question 2: How do non-specialist mathematics teachers implement the curriculum in the intermediate phase at Tongaat schools?

In understanding how the participants implement the curriculum and in responding to the second research question of the study, I first had to establish an understanding of their level of knowledge on mathematics, teaching style and approach. The study used Shulman's model of teacher knowledge to identify and theorise the participants' PCK and SMK. Five out of the seven participants indicated that they do not have a solid understanding of mathematics, which does affect their teaching. This statement was found to be true during the lesson observations. Many of the participants made mistakes whilst teaching and it was evident in some of their lesson plans. In terms of the approach they used, the findings have indicated that most of the participants adopted a teacher-centred approach, with only two participants enacting a learner-centred approach. The lessons were textbook-driven, with the participants reading and then getting learners to complete the activity. It should be noted that a pedagogy that relies heavily on textbooks inhibits learners' ability to solve problems and make decisions (Serin, 2018). Serin (2018) further argues that, for this reason, the teacher-centred approach received much

criticism since the teacher oversees instruction and has the final say. Learners do not get sufficient opportunities to develop and practise critical thinking and problem-solving techniques. On the other hand, the learner-centred approach is where the teacher allows learners to be active in the learning process, thus allowing learners to be independent and to build their collaboration and communication skills. The two participants who used a learner-centred approach were also identified as the only two who had a passion for teaching mathematics as they enjoyed the subject. Their approach to teaching was also visibly different from the rest of the participants. These differences arose from their teaching style, attitude towards the learners, use of resources, and their relationship with the learners. The two participants who were able to make use of a learner-centred approach could only do so because they had a solid understanding of mathematics and were confident in teaching it.

The findings revealed that in terms of lesson planning and preparation, all the participants indicated that they use the CAPS document and ATPs. After checking three of the participants' lesson plans during the lesson observation, I found that there was a disconnect between the aims and objectives of the lesson with the assessment given to the learners. Furthermore, the assessments that some of the participants conducted were not effective in attaining the required result. For example, one of the participants was conducting a self-assessment and was only checking the learners' work at the end of the week. Regular feedback and monitoring of the learners' work were not done. Feedback that is given several weeks or months after the completion of the specific learning material will be irrelevant and will have no bearing on the learning of the learners (Obilor, 2019). Thus, learners' misconceptions may have been ignored or attended to, too late in instances like these. On the other hand, the participant who displayed a solid understanding of SMK and PCK made use of continuous assessment. With this form of assessment, regular feedback was provided to the learners and the teacher could reflect on her lesson. Shulman's model of teacher knowledge highlights the significance of teachers having a sound understanding of pedagogy and content knowledge. In other words, solid content knowledge that is pedagogically sound gives teachers the tools they need to instantly synthesize the actions, thinking, theories, and morals of classroom situations (Ball & Bass, 2000). The findings from the teachers' responses and lesson observations indicated a lack of these aspects which are crucial in teaching effectively. Teaching becomes more effective when teachers are knowledgeable about the subject matter, the pedagogy associated with the subject matter, and the cognitive processes of the learners (Walshaw, 2012). Understanding the teacher's PCK enabled me to gather information about the teachers and their teaching.

The findings have responded to the key research questions. The discussion above reveals the ways in which the participants implemented the curriculum. A common finding relates to lack of SMK and PCK amongst the participants that affected their teaching. The subsequent section will discuss the implications of the findings.

6.3 Implications of the study

The previous section discussed the findings in relation to the key research questions of the study. The findings have implications for policy, practice, and research, which I discuss in this section.

6.3.1 Implications for policy

The findings indicated that the participants experienced numerous challenges in implementing the curriculum as non-specialist mathematics teachers. These challenges have affected their teaching and confidence in the classroom. The findings have shown that, whilst the participants made use of the CAPS document and ATP's to plan their lessons, it was insufficient. They were unable to teach and plan effective assessment despite having all the relevant information. Therefore, there is a need to revise existing policies and develop ones that are user-friendly to all the teachers, especially novice teachers. The instructions should be clear and concise. In the same vein, the Department of Basic Education should establish new policies that place teachers in schools matching their specialisations to avoid similar challenges faced by the participants in the current study.

6.3.2 Implications for practice

The findings have shown that most of the participants do not have a positive attitude towards teaching as non-specialists. To promote a positive attitude, it is important that teachers are provided with continuous support and training, especially in the cases of non-specialist teachers teaching core subjects like mathematics. Non-specialist teachers should be able to seek guidance from subject specialists by forming support groups through social media or instant messaging platforms such as WhatsApp. Moreover, curriculum advisors should offer materials with information that will enable the teachers to plan effectively and enact the curriculum. In this way, non-specialist teachers can consult these documents when they are uncertain. Furthermore, it is also suggested that current training programmes should be re-evaluated to

ensure they speak to the challenges experienced by teachers. The findings have also highlighted that most of the participants adopted a teacher-centred approach during their lessons for various reasons, and the reasons could be limited content knowledge or inability to manage discipline. Hence, the findings from this study indicate that there is a need for the relevant stakeholders to make regular visits to schools to check on teachers and ensure that they are receiving the support and training that they need.

From the above discussion, it is worth mentioning that the two teaching approaches are essential in any school curriculum, since each has its strengths and weaknesses. For a very effective learning system, both approaches should be used together to achieve the best results. The study has also highlighted that the participants further alluded to the issue of training and support. They stated that they did not receive support from their SMTs and curriculum advisors. Furthermore, the lesson observations have demonstrated that most participants did not use resources to enhance their teaching. Many of the classrooms did not have charts. Resources should therefore be made available to teachers, especially non-specialist teachers, to assist them in teaching. Furthermore, the Department of Basic Education, as mentioned earlier, should develop a system of ensuring that core subjects should only be allocated to specialist teachers. This will eradicate issues contributing to the poor pass rate in mathematics and ease the pressure faced by non-specialist teachers.

6.3.3 Implications for future research

There is a global shortage of STEM teachers (Preez, 2018). The study of mathematics promotes holistic human growth and is useful in everyday life (Hodaňová & Nocar, 2016). All STEM areas have their foundation in mathematics (Preez, 2018). and South Africa is underperforming in mathematics (Mapaire, 2016). Whilst research has alluded to the factors contributing to poor performance in mathematics, not much has been done to address the issue. Considering the above finding, limited research has been done on the differences in motivation among entrants to teacher education, as well as how such motivations are formed (Malmberg 2006). It is suggested that further research be undertaken into the development of specific recruitment procedures in attracting the best students to meet the need for certified mathematics teachers. The goal of increasing the number of excellent, qualified, and dedicated mathematics teachers in South Africa can possibly be achieved by developing strategies based on an understanding of what factors attracted or influenced students who had already chosen mathematics as their area of specialisation at the university level. Therefore, there is a need to research this area of

work; such studies will assist the various institutions, schools and departments in understanding the plight of non-specialist mathematics teachers.

6.4 Limitations of the study

The focus of this study was on an exploration of the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools. The study was undertaken within the context of KwaZulu-Natal, specifically located in the Tongaat area. The study comprised seven non-specialist mathematics teachers from surrounding schools in Tongaat. The findings presented in this study are the participants' own experiences, therefore the findings cannot be generalized. However, it is recommended that further research be conducted on the experiences of non-specialist teachers that draws a greater sample size and that extends to areas outside KwaZulu-Natal. Furthermore, as a non-specialist mathematics teacher, there was a concern about my own subjectivity regarding the information gathered from the participants. However, I used a reflective journal to note down key points and to avoid interference with the experiences of the participants. Additionally, semi-structured observations and interviews were conducted to allow participants to engage and provide their experiences without being restricted by a tight schedule.

6.5 Conclusion

This study sought to understand the experiences of non-specialist mathematics teachers in the intermediate phase. Primarily, the focus was on how they implement the curriculum in the absence of specialised knowledge. The findings have indicated that most of the participants in the study entered the profession due to extrinsic reasons and pointed out that they do not love mathematics. These were the first contributing factors that affected their experiences as non-specialist teachers. Adding to the challenge of being a non-specialist teacher was the issue of the lack of training and support provided by SMTs and curriculum advisors. Such factors have shown to have contributed negatively to teaching and learning. Therefore, for teachers to successfully manage implementation and the issues they confront, it is necessary to understand them and to offer them continual support, assistance and advice.

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Appendix 1 – Informed Consent form

University of KwaZulu-Natal

Edgewood Campus

Private Bag X03

Ashwood

3605

Dear Prospective participant

Request for participation

My name is Risha Rambali, I am a Masters of Education student at the University of KwaZulu Natal, Edgewood Campus in Pinetown. The title of my study is: Exploring the experiences of non-specialist Mathematics teachers in implementing the curriculum in the Intermediate phase at Tongaat schools and you are invited to participate in my study. The purpose of the study is to explore how non-specialist Mathematics teachers implement the curriculum by making sense of their experiences.

I intend to observe one lesson in your classroom and also have a semi-structured interview with you. This is to gain an in-depth understanding of your teaching experience as a non-specialist teacher and how you implement the curriculum. The duration of the study will be between three to four weeks. I will introduce myself to the school and meet with you and discuss the way forward. Although, there is research done on non-specialist teachers, very little is known about their experiences and how it impacts on curriculum implementation. The research could provide beneficial information to the Department of Education regarding the allocation of core subjects to non-specialist teachers and the impact thereof. The study does not aim to assess or critique your teaching but to gain an in-depth understanding of your experiences of teaching a subject that is out of your specialism.

Should you require to contact me, my supervisor or the UKZN Ethics office, please see details below:

Researcher	Supervisor	UKZN Ethics office
Name: Risha Rambali Qualification: Bed Honours Cell number: [redacted] Email: [redacted]	Name: Dr Vusi Msiza Qualification: PhD Cell number: [redacted] Email: [redacted]	Research Office, Westville Campus Govan Mbeki Building Private Bag X 54001 Durban 4000 KwaZulu-Natal, SOUTH AFRICA Tel: [redacted] Fax: [redacted] Email: [redacted]

Kindly note the following:

1) The information provided will be treated with the utmost confidentiality and pseudonyms will be used to protect your identity.

2) Your participation in the study is strictly for educational purposes.

3) Your responses should reflect your own opinion, hence there is no right or wrong answers.

4) You may withdraw at any stage, for any reason during the course of the study without any repercussions.

5) The interview may take around 60 minutes and you will not be forced to disclose information which you do not wish to disclose.

6) If you accept the invite to be interviewed and observed, please indicate whether you will allow the interview to be recorded by ticking as applicable:

Data generation method	Equipment	Consent	Do not consent
1) **Interview**	Audio equipment		
	Photographic equipment		
	Video equipment		

Thanking you in advance

Risha Rambali

Declaration

I _____ (Full name of the participant hereby confirm that I understand the contents of this letter and the nature of the research project and I consent to participating in the study.

I understand that my identity will be kept confidential and that I am at liberty to withdraw from the study at any time, for any reason without repercussions.

_____ _____

Signature of the participant **Date**

Appendix 2- Letter to the Principal

University of KwaZulu-Natal

Edgewood Campus

Private Bag X03

Ashwood

3605

Letter requesting permission to conduct research in school: Principal

Dear Sir/ Madam

My name is Risha Rambali, student number 213537436, I am a Masters of Education student at the University of KwaZulu Natal, Edgewood Campus in Pinetown. The title of my study is: **Exploring the experiences of non-specialist Mathematics teachers in implementing the curriculum in the Intermediate phase at Tongaat schools**. The study aims to explore how non-specialist Mathematics teachers implement the curriculum by making sense of their experiences.

I intend to observe one lesson in the teachers' classroom and also have a semi-structured interview with them. I hereby request permission to conduct research in your school with a non-specialist Mathematics teacher in the intermediate phase. The research will not compromise teaching and learning as interviews will take place online after school hours.

Participants will be notified in due course of the date for the interview. Participation in this study is voluntary and participants may withdraw at any stage, for any reason, without any repercussions. The information obtained from the participants will be kept confidential as well as the name of the school and the participant. Although, there is research done on non-specialist teachers, very little is known about their experiences and how it impacts on curriculum implementation. The research could provide beneficial information to the Department of Education regarding the allocation of core subjects to non-specialist teachers and the impact thereof. The study does not aim to assess or critique teachers' teaching but to gain an in-depth understanding of their experiences of teaching a subject that is out of their specialism.

Should you require to contact me, my supervisor or the UKZN Ethics office, please see details below:

Researcher	Supervisor	UKZN Ethics office
Name: Risha Rambali Qualification: Bed Honours Cell number: [redacted] Email: [redacted]	Name: Dr Vusi Msiza Qualification: PhD Cell number: [redacted] Email: [redacted]	Research Office, Westville Campus Govan Mbeki Building Private Bag X 54001 Durban 4000 KwaZulu-Natal, SOUTH AFRICA Tel: [redacted] Fax: [redacted] Email: [redacted]

Thanking you in advance
Risha Rambali

Declaration

I _____ (Full name of the school principal) hereby confirm that I have read and understood the contents of this letter and the nature of the research project. I hereby grant permission for _____ (Researcher's name) to conduct her Masters of Education research at my school, by observing one lesson of a non-specialist Mathematics teacher in the intermediate phase and one interview.

I understand that all the information will be kept confidential and will only be used for the educational purpose of her Masters of Education degree.

_____ _____

Principal Date

School stamp

Appendix 3 - Letter to the Parents

University of KwaZulu-Natal

Edgewood Campus

Private Bag X03

Ashwood

3605

Letter of permission: Parents

Dear Sir/Madam

My name is Risha Rambali, student number 213537436, I am a Masters of Education student at the University of KwaZulu Natal, Edgewood Campus in Pinetown. I intend to conduct a study in the school that your child is in. The title of my study is: Exploring the experiences of non-specialist Mathematics teachers in implementing the curriculum in the Intermediate phase at Tongaat schools. The study aims to explore how non-specialist Mathematics teachers implement the curriculum by making sense of their experiences.

I intend on observing one lesson in the classroom in which your child may be present. The study will not affect your child's identity or disturb teaching and learning. Your child will not be requested to participate or answer any questions during the study. Furthermore, your child's responses during lesson sessions will not be included in the study. All the information gathered from the observation will not be used to discriminate against any learner or be used to ridicule or undermine any learner. The observation will merely be done to observe the teacher and how the teacher teaches and implements the curriculum. You are not obliged to give consent should you be uncomfortable with having your child present during the observation. The study aims on providing beneficial information to the Department of Education by exploring the experiences of non-specialist Mathematics teachers' in implementing the curriculum. Therefore, the information gathered from the study is strictly for educational purposes.

Should you require to contact me, my supervisor or the UKZN Ethics office, please see details below:

Researcher	Supervisor	UKZN Ethics office
Name: Risha Rambali Qualification: Bed Honours Cell number: [redacted] Email: [redacted]	Name: r Vusi Msiza Qualification: PhD Cell number: [redacted] Email: [redacted]	Research Office, Westville Campus Govan Mbeki Building Private Bag X 54001 Durban 4000 KwaZulu-Natal, SOUTH AFRICA Tel: [redacted] Fax: [redacted] Email: [redacted]

Thanking you in advance
Risha Rambali

Declaration

I_____Parent of _____ (Learners name) hereby confirm that I understand the contents of this letter and the nature of the research project and I grant permission for _____ (Researchers name) to conduct her Masters of Education research study in the classroom in which my child is in by observing one lesson. I understand that my child will not be required to participate in any activity pertaining to this study.

_____ _____

Parent **Date**

Appendix 4 - Learner assent form

University of KwaZulu-Natal

Edgewood Campus

Private Bag X03

Ashwood

3605

Learner assent form

Dear learner

My name is Risha Rambali and I am a Masters student at the University of Kwa-Zulu Natal, Edgewood Campus. I am currently doing a study for research purposes on how Non-specialist mathematics teachers teach and implement the mathematics curriculum. During my research, I will be visiting your classroom to observe your teacher and not interact with you in anyway. However, your consent is needed for me to complete my study as you will be present in the class during my observation. Kindly tick the appropriate box below to confirm if you agree to my presence in the classroom.

Name of learner: _____

Surname of learner: _____

Date: _____

*Please tick the appropriate box below

☐ Yes

☐ No

Should you require to contact me, my supervisor or the UKZN Ethics office, please see details below:

Researcher	Supervisor	UKZN Ethics office
Name: Risha Rambali Qualification: Bed Honours Cell number: [redacted] Email: [redacted]	Name: Dr Vusi Msiza Qualification: PhD Cell number: [redacted] Email: [redacted]	Research Office, Westville Campus Govan Mbeki Building Private Bag X 54001 Durban 4000 KwaZulu-Natal, SOUTH AFRICA Tel: [redacted] Fax: [redacted] Email: [redacted]

Thanking you in advance

Risha Rambali

Appendix 5- Data Collection Instrument

Semi-structured interview schedule

Part 1: Information

Name of the participant: _____ Time: _____

Date of the interview: _____/_____/2021 Place: _____

Name of school: _____

Part 2: Interview questions

1. Introductory questions

- Tell me about yourself?
- Where are you from?
- How long have you been teaching?
- Why did you become a teacher?
- What is your degree subject specialisation?
- How did you become a non-specialist Mathematics teacher?

2. Describe how you feel about teaching Mathematics as a non-specialist teacher?

3. Do you feel that you have been given adequate training to implement the Mathematics curriculum as a non-specialist?

4. How do you plan your lessons? And what kind of support do you get from your managers and curriculum advisors?

5. Which teaching method/approach do you use when teaching Mathematics?

6. Why do you use that teaching method/approach?

7. Do you have alternative methods/approaches for teaching Mathematics?

8. How do you assess learners understanding of the content being taught?

9. Do you think core subjects like Mathematics should be allocated to subject specialists? If so, why?

10. If you had a choice, would you change from teaching Mathematics to another subject? Explain the reason for your choice.

11. What are the challenges that you face when implementing the Mathematics curriculum in your classroom?

12. What are your suggestions for the allocation of subjects for future teachers?

Semi-structured observation schedule

Part 1: General information

Name of the participant: _____ Time: _____

Date of the observation: _____/_____/2021 Place: _____

Subject: _____ Lesson topic: _____

Grade: _____ Number of learners: _____

Name of school: _____

Part 2: Main predetermined observation aspects.

1. Lesson delivery (Teachers subject content and pedagogical content knowledge, teaching style and is the content presented and explained correctly).

2. Learner interaction (Teachers reactions and the type of support given to learners who do not understand the content).

3. Classroom ethos (Are learners fully engaged in the lesson? Does the classroom have mathematics resources?).

4. Assessment of learners (How does the teacher assess/ measure learners understanding of the content taught?).

5. Teacher confidence (Is the teacher confident when teaching and implementing the curriculum?).

6. Teaching aids or resources use in the lesson.

Appendix 6- Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

06 January 2022

Risha Rambali (213537436)
School of Education
Edgewood Campus

Dear R Rambali,

Protocol reference number: HSSREC/00003653/2021
Project title: Exploring the experiences of non-specialist Mathematics teachers in implementing the curriculum in the Intermediate phase at Tongaat schools
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 24 November 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 06 January 2023.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/ms

Appendix 7- KwaZulu-Natal DOE Approval

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE HEAD OF DEPARTMENT

Private Bag X9137, PIETERMARITZBURG, 3200
Anton Lembede Building, 247 Burger Street, Pietermaritzburg, 3201
Tel: 033 392 1063
Email: Phindile.duma@kzndoe.gov.za

Enquiries: Phindile Duma **Ref.**:2/4/8/1814

Miss R Rambali
[redacted]
VERULAM
4000

Dear Miss Rambali

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"EXPLORING THE EXPERIENCES OF NON-SPECIALIST MATHEMATICS TEACHERS IN IMPLEMENTING THE CURRICULUM IN THE INTERMEDIATE PHASE A TONGAAT SCHOOLS"**, in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the Intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 11 October 2021 to 13 September 2023.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers above.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

PINETOWN DISTRICT

[redacted]

Dr MJB Mthembu
Acting Head of Department: Education
Date: 14 October 2021

GROWING KWAZULU-NATAL TOGETHER

Appendix 8- Language Editor's Certificate

Crispin Hemson
[redacted]
Durban
South Africa 4001

[redacted]

This is to confirm that I have undertaken language editing of a Masters dissertation by Risha Rambali, entitled ***Exploring the experiences of non-specialist mathematics teachers in implementing the curriculum in the intermediate phase at Tongaat schools***

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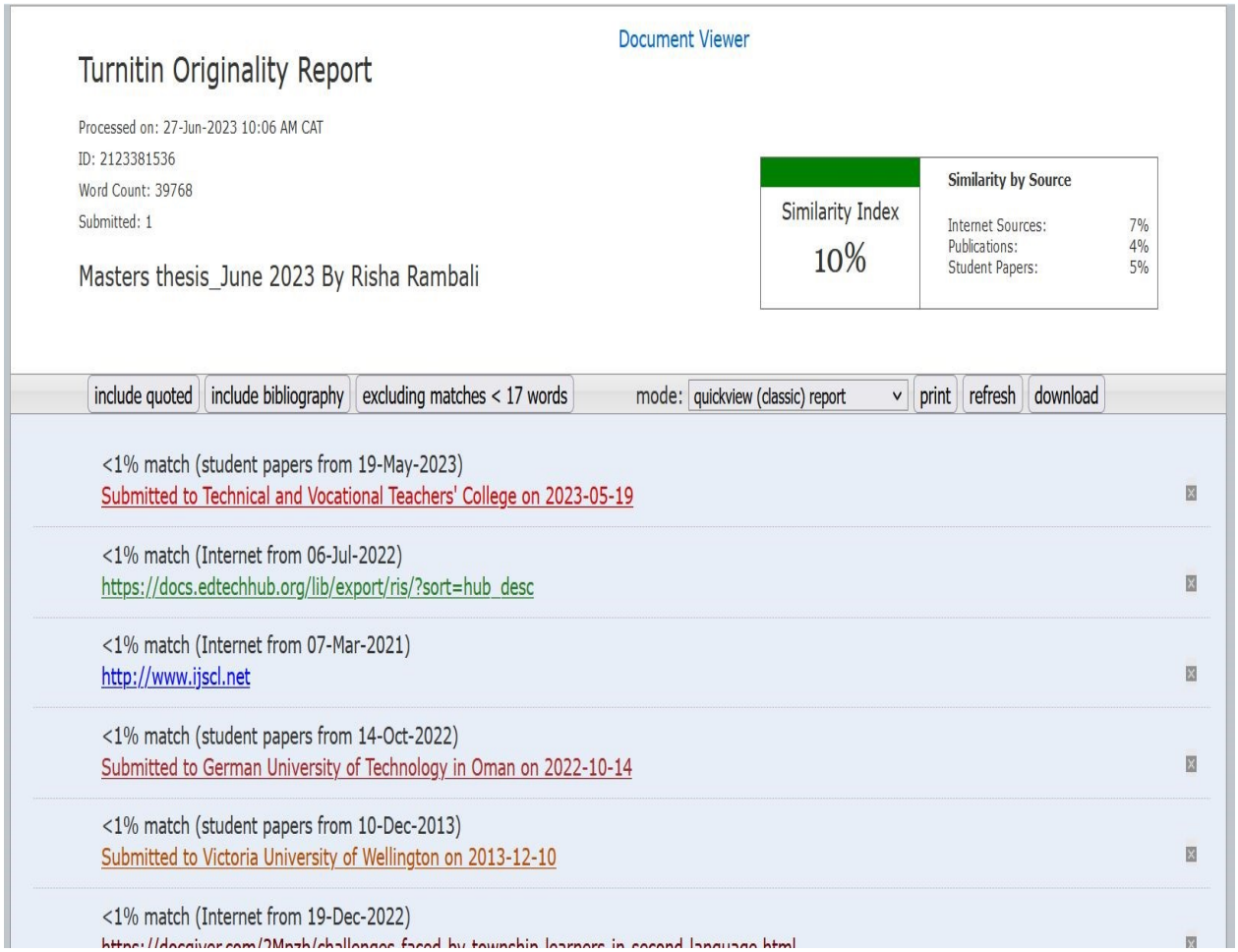
[redacted]

10th July 2023

Appendix 9- Turnitin Report



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